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H. H. Brown, Editor
L. S. Blodgett, Managing Editor
Warner Lumbard, Associate Editor

James Swan, Contributing Editor

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The Four-Day Liners

CERTAINLY no private proposal of recent years has aroused more curiosity or provoked more discussion than the plan made public last year of running a line of daily four-day liners between America and Europe.

Some months ago this paper, in commenting editorially upon the matter, expressed the opinion that although the scheme, from an engineering point of view, was doubtless practicable, the enormous amount of money needed in order to materialize it would be prohibitive, or at any rate would involve government backing and support on an unprecedented scale.

Since that time much has happened. Apparently it has been brought home to the promoters of the proposed line that, in order to maintain an average sea speed of from 32 to 35 knots, much larger ships would be needed than were at first anticipated. It has followed that the tentative sailing schedule has been cut in half—departures to be made every other instead of every day. The size of the ships has been greatly increased, and their number reduced—we believe from 10 to 6. Incidentally, this is in line with a suggestion in the editorial above referred to.

Furthermore, and most important, a shipping bill has become law which makes available large sums of money, at low interest rates, for the building of privately owned American vessels.

Thus, on two counts, at any rate, the four-day liners are nearer realization—a more practicable sailing schedule has been adopted and Government aid on a large scale has been made available. Notwithstanding these facts, the Shipping Board has submitted to the Senate an adverse report on the proposal.

While the board's report may have been somewhat of a surprise to many people, there having been, apparently, a somewhat widespread feeling that the scheme was "going through," it appears that in view of the character of the evidence and material submitted to it, the board did not feel that it could, conscientiously, come to any other decision.

Following what cannot be considered otherwise than a very wise line of action, one which should have produced convincing results, the promoters of the proposed line had submitted to committees of experts the various phases of their scheme, naval architecture, engineering, economics and finances. The members of these committees were well and favorably known in this country; they were men of established reputations in their respective lines of business. Summaries of these several reports were combined in a pamphlet which, as we understand it, while not giving all the details of each report, gave its essence. While the board was undoubtedly furnished with the details, the pamphlet gives in fair outline the basis of the proposal upon which the board was requested, by the senate, to express its opinion.

A somewhat similar line of action was followed in the building of the *Mauretania* and *Lusitania*. With both the Cunard ships and the great liners now under consideration, past experience could furnish but an imperfect guide for the designers—they were reaching out into almost unknown and little explored territory; and in order to insure success in meeting the unprecedented conditions imposed upon them, they had to develop to the utmost every possible source of knowledge bearing upon their problems, every line of scientific investigation which might throw light upon the uncertain path ahead of them. With the British ships, all this was done; no stone was left unturned; with a result which was, without doubt, one of the greatest engineering achievements of all time.

The promoters of the four-day ships have made a start in the right direction—they have submitted their problem to experts of unquestioned ability; but the results so far made public are not convincing, and one cannot but feel that until the technical and engineering

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features of the undertaking are in a far more advanced stage than apparently exists at present, the Shipping Board could follow no other course than to withhold judgment until evidences of scientific study and investigation, comparable with that which preceded the building of the great Cunard liners, are placed before them. Lacking this, the board would appear to have no other course than to disapprove the proposition as submitted.

The financial and economic reports, which are included in the promoters' statement, may be passed over until the proposal takes more concrete form. It appears, however, that the estimated cost of construction is rather on the low side, particularly in view of the probability that the ships, if built, will very likely have to be somewhat larger than at present contemplated.

Given 35-knot vessels, it would appear that the schedule of sailings as laid out by the committee on operation is practicable and could be carried out, although the board does not concur in this view.

In the field of naval architecture, considerable of a technical nature has evidently been accomplished. The development of the hull design has made clear the importance of length, at least, if not of absolute size, in maintaining the unusually high speed. One very considerable increase has already been decided upon, and it would not be surprising if a further addition in length would be made, before the final and satisfactory design dimensions are arrived at.

So far as hull weight is concerned, it is not apparent that any radical reduction from previous practice in transatlantic liners could very safely be indulged in. High tensile material can be made to save weight, where tensile stress alone has to be met; and it was extensively made use of in building the *Mauretania*. Unfortunately, however, long high-powered ships suffer quite as much from sagging as from hogging strains, and the deck compression resulting from the former can be met no better by high tensile than by ordinary ship steel—only sectional area of material, with its accompanying weight, can take care of this condition.

In view of the fact that these ships will have to be driven far harder than any at present in service, it would appear that structurally they must be at least equal in strength to the best of their predecessors; and such details of equipment and fittings as are directly exposed to wind and wave must be even more robust than what is now considered safe and satisfactory.

So far as accommodation plans are concerned, while important, they appear a somewhat secondary matter at this stage of the proceedings. In this respect, the Shipping Board's criticism of the promoters' plans appears somewhat premature, and although their points may have been well taken, they would best have been omitted from the report to the Senate, because, in comparison with the other matters discussed, they are trivial and altogether susceptible of satisfactory adjustment at a later stage of the development.

By all means the most important and—to many of those who have seen it, the least satisfactory portion of the prospectus is that devoted to engineering.

The problem presented by the propelling machinery, first in the selection of type, and second in detail design, is by far the most important which has to be met in the design of these vessels; and, when one learns that the type of machinery is not yet even settled, further comment seems rather superfluous. Whatever the type, the weight alloted to machinery is apparently such that a close approach to what is generally known as naval practice will be necessary, and it is an open question how far this type of propelling machinery and auxiliaries can be modified to meet the requirements of transatlantic service without a material increase in weight.

One cannot but feel that as the design of these vessels is developed in all its details, the necessity of great strength and ruggedness of both hull and machinery will demand more weight and a larger ship than has as yet been proposed. The building of four-day ships is quite possible so far as the technical and engineering side is concerned, but to maintain such a schedule will require ships of enormous size and cost. The commercial success of such an undertaking is at best, problematical; but more than commercial success is involved in the project. For many reasons, it is likely that the Government will lend a helping hand, once it is convinced that a firm technical basis of design has been established, and that a large and definite amount of private capital is actually available; but until the scheme has reached a greater degree of "crystallization" than is yet apparent, it is unlikely that the Shipping Board will feel justified in giving the proposal its unqualified approval.

Old Names for New

THE reported sales by the American Brown Boveri Electric Corporation of its shipyard at Camden, New Jersey, will, in the minds of many, raise at once the question of what the future name of this great Delaware River shipyard is to be.

As the plant of the New York Shipbuilding Company, the Camden yard, from the date of its first contract in 1900 to its taking over by the American International Corporation and assimilated companies in 1917, made for itself an enviable reputation. Conceived by the late Henry G. Morse, the "New York Ship", as it came to be known, differed materially in plant layout and also in methods of work from its predecessors both in this country and abroad. Although both Mr. Morse's plant and the methods followed in it were the subject of much criticism and even of ridicule, he lived to see his judgment in large part vindicated and his plant firmly established as one of the foremost shipyards of America.

Broadly speaking, his method of hull construction was an application of bridge construction to shipbuilding and, with minor modifications, it has come into general

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use in all large shipyards in this country. It should be noted in passing, however, that a somewhat similar system had been in use on the Great Lakes for many years before work commenced at Camden but its practical application was more limited. The comparative advantages of the two systems have been the subject of much discussion but the coast yards, particularly during the late war, have followed to a very great extent the Camden system. The fabrication of hull structural work, as practiced in this country from 1917 to 1920 with such astonishing results, was but an expansion of what Mr. Morse had in mind when the Camden plant was established in 1900.

The New York Shipbuilding Company, as the concern was known from 1900 to 1917, turned out a large number of fine vessels, among them the *Texan* for the American Hawaiian Line, the *Mongolia* and *Manchuria* for the Pacific Mail, the *Massachusetts* and the *Mississippi* for the Atlantic Transport and the *President, Governor* and *Congress* for the Pacific coast. It built a large fleet of steam colliers, many oil tankers, and more steel car floats than any other yard in the country. Mention should also be made of the *Robert Fulton* and *Washington Irving,* built for the Hudson River Day Line, the former going out on trial less than four months from the day her keel was laid. For the Navy were built the cruiser *Washington,* now the *Seattle* and the first large vessel of our modern navy to be completed within the stipulated contract time; the battleships *Kansas, New Hampshire, Michigan, Utah, Arkansas* and *Oklahoma;* the destroyer tender *Melville* and a number of destroyers. For foreign navies were built the Argentine battleship *Moreno* and the Chinese cruiser *Fei Hung.* For other departments of our own government were built eight lighthouse tenders, 10 steam-propelled lightships, three mine planters and two revenue cutters. Altogether this makes a rather impressive list.

In 1917 the company was taken over by a combination headed by the American International Corporation and the plant was greatly expanded. During and just after the war an enormous tonnage was completed for both the Navy and the Shipping Board, the working force totalling at times close to 20,000 men.

After the completion of the war work, this company, in common with all others, suffered from the extreme reaction which depressed the shipbuilding business and about two years ago the plant was sold to the American Brown Boveri Electric Corporation. Since that time it has completed the great airplane carrier *Saratoga* but it is understood that a considerable portion of the plant has been devoted to work not of a marine character.

The present reported sale will give rise to the hope that the name "New York Shipbuilding Company" may be restored—certainly such will be the wish of all who in one way or another were in the past connected with the old company. The old name carries with it an enviable reputation and—without the slightest disrespect to the present owners—it is submitted that it is a much better name for a shipyard than the present one.

The Mail Contracts

SOME of the results expected from the passage of the Jones-White shipping bill began to take shape during the first month after it became a law. The Postmaster General has taken the first steps toward putting into effect the provisions of the law relating to mail contracts and expects to receive bids shortly covering several foreign mail routes. In a communication addressed to the chairman of the Shipping Board certifying seven ocean mail routes which should be established or operated for the carrying of mails as contemplated by the new law, the Postmaster General pointed out that, generally speaking, the speed of American ships required for these services should be such as to enable the Post Office Department to give them a preference in the assignment of mails in competition with ships of foreign registry. The recommendation for the seven routes was approved by the Shipping Board and on June 11 the Postmaster General announced that advertisements would be placed in Atlantic and Gulf port newspapers inviting bids returnable by July 9 on five routes, including services to Mediterranean and Black Sea ports, to Cape Town, South Africa, and to both the east and west coasts of South America. "The advertisements," said the Postmaster General, "call for an improved service and will necessitate the construction of new vessels in American yards during the term of the contracts."

Following this, the Shipping Board let it be known on June 22 "that it is the sense of the board that mail contracts under the Jones-White shipping legislation should provide for new or improved vessels for the services, the first of such vessels to be entered on the service not later than three years after the signing of the mail contract." In issuing this statement the Shipping Board explains that in enacting the Jones-White Act Congress has unmistakably recorded its purpose to build up a privately owned American merchant marine comparable in quality with the fleets of other nations.

This interpretation of the purpose of Congress would undoubtedly be accepted in good faith by shipowners and others interested in the future of American shipping, if it were not used as a club by the Shipping Board to restrict and hamper the actions of private shipowners in attempting to comply with the provisions of the law. Private shipowners naturally feel that replacements should be left to the judgment of the owners of the vessels. The Jones-White Act was passed in the belief that it would aid private shipowners in taking over government lines and developing them as a private business enterprise. By no stretch of the imagination can authority be found in the language of the Jones-White bill for the Shipping Board to assume the position of dictator or director in the affairs of private shipowners. Government restrictions and interference will only tend to nullify the purpose of the bill.

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Shipowners and Shipbuilders Are Optimistic Over the Outlook

Favorable provisions of the Jones-White bill will enable private owners to build new ships

AS a result of the enactment of the Jones-White shipping bill American shipowners and shipbuilders are looking forward with confidence to greater activity in the marine field. The favorable provisions of the Marine Act of 1928 open the way for the development of private American shipping in foreign trade, the sale of existing Government lines to private owners, the construction of fast passenger and cargo vessels and the modernization of ships now in operation.

The enactment of this constructive legislation is looked upon generally as a long step in the right direction towards the rehabilitation of the American merchant marine and both shipowners and shipbuilders are very hopeful that the benefits derived from this initial step will lead to the enactment of further helpful legislation as its need is disclosed. Already plans are taking shape for the construction of new tonnage in American yards and a general feeling of optimism is spreading throughout the marine industry, as is shown by the following statements of various leaders in the field regarding the outlook.

Jones-White Bill Very Helpful

By P. A. S. Franklin

President International Mercantile Marine Company

The Jones-White bill is a good constructive measure and should be very helpful in the development of the American merchant marine.

Predicts Orders for 150,000 Tons of New Ships Within a Year

By C. A. McAllister

President American Bureau of Shipping

Shipbuilding in this country will be stimulated in a marked degree by the passage of the Jones-White bill. I predict that the passage of the bill will result in the placing of contracts in American shipyards for about 150,000 tons of new vessels for foreign trade inside of a year.

Will Stimulate Healthy Progress in Shipping and Shipbuilding

By T. V. O'Connor

Chairman United States Shipping Board

The Merchant Marine Act of 1928, which became law with the signature of President Coolidge, is notice to the maritime world that the United States is on the sea to stay. This constructive legislation will stimulate the development of our private shipping in the foreign trades and will have the effect of hastening the transfer of Government-owned tonnage to private American hands for operation on a permanent basis, at the same time safeguarding against the abandonment of American flag services in those trades where it may yet be impossible for private ownership to attain success.

I am confident that the new act will result almost immediately in the construction of new vessels and the improvement of old ones for our merchant marine. Private operators, some of whom have purchased their ships from the Shipping Board, will, I understand, shortly avail themselves of the benefits of the new merchant marine act. This means busy shipyards and busy shipyards increase national security and local pay rolls in many seacoast and interior States.

What the foreigners have done with their lines Americans will do and do better. Fine and fast as the foreign ships are, finer and faster American ships will be launched as a result of the Jones-White law. They will meet the competition of other countries' ships with the unfaltering support of their Government and their people.

We are on our way to a new merchant marine which will carry us back to our old place of dominance. In 1920 Congress gave us a merchant marine policy. In 1928 it gives us the means to carry it out.

Dollar Line to Build Ships

By R. Stanley Dollar

Vice-president The Dollar Line

The Dollar Line has definitely decided to go ahead "right away" with the building of two or three "larger and faster" passenger liners.

We have determined upon the principal features of these vessels, and are now prepared to draw up the specifications. As to steam or motor power, we are open to conviction either way.

We have no spare equipment at the present time and therefore we want additional vessels of the latest type.

To Build Four 10,000-Ton Passenger and Cargo Steamships

By H. E. Frick

Vice-president American Export Lines

This corporation has under preparation plans for a 10,000-ton deadweight combined passenger and cargo steamer with accommodations for approximately 100 passengers and a speed of 14 knots. We propose building four vessels of this type to be used between New York and the Levant

Our plans are contingent upon being allocated a mail contract under the mail provisions of the Jones-White bill and financing 75 percent of the cost from the construction loan fund under the provisions of this bill.

We consider the Jones-White bill a most constructive piece of shipping legislation. It undoubtedly will result in many of the essential trade routes, now being operated for account of the Shipping Board, being taken over for private operation.

We are extremely optimistic as to the future as a result of this piece of legislation.

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Hopes Prospects Will Prove Favorable for Building New Ships

By Frank C. Munson

President Munson Steamship Line

It is too early to give any opinion on the effect of the passage of the Jones-White bill on the shipbuilding program. It will take another three months until the mail contract and other arrangements could be made before we would build, although prospects, we hope, will be favorable.

Shipping Men Are Greatly Heartened

By Franklin D. Mooney

President Atlantic, Gulf & West Indies Steamship Lines

The Jones-White shipping bill is the most constructive measure yet put forward to aid the American merchant marine.

Shipping men are greatly heartened over the passage of the bill, and I do not doubt that it will result in the construction of a large number of ships for the foreign trade. Shipping itself will not only be benefitted, but all of its allied industries. American shipping men are able to face the future with confidence now that the government has so helpfully come to their aid.

Shipyards Can Now Pull Themselves Out of the Slough of Despond

By C. Stewart Lee

Vice-president Pusey and Jones Corporation

We cannot make too plain our belief and faith that the Jones-White bill will materially assist the shipbuilding of this country. There are many things which, selfishly, one might wish changed, but this is a long hoped-for step in the right direction. We believe that in the final analysis the American shipyards can now pull themselves out of the "slough of despond."

We hear of a great many new projects, and have no doubt some of them will materialize before very long, but we are not in position to give any definite figures as to type, tonnage and speed.

Grace Line Will Build Future Vessels in American Yards

By Galen Carter

President Grace Line Inc.

In our opinion the Jones-White bill should be a great stimulus to American shipping, not only in enabling the Shipping Board to sell most of the lines they are still operating, but also to enable privately owned American lines to build new vessels in American yards either to increase their services or to replace their obsolete ships.

The motorships which we ordered from foreign shipyards will be operated under the American flag, and were built abroad only because of the high cost of building in American yards, making it impossible for us to successfully compete with our foreign competitors.

This situation is now changed by the Jones-White bill, the provisions of which in added mail revenues and government loan fund should be sufficient to offset the higher building cost, and therefore we expect that any future additions for our lines willl be built in American yards. It is too early to state when the demands of our trade will warrant our further increasing our fleet, but we hope it will be in the near future.

To Build Two Automobile and Freight Carrying Motorships

By C. K. Crosby

General Manager Hudson River Navigation Corporation

Our company has already made application to the Shipping Board construction loan fund for 50 percent of the cost of construction of two Diesel automobile and freight carrying vessels and we anticipate increasing the amount of this request to 75 percent in accordance with the plan incorporated in the Jones-White bill.

In our opinion the Jones-White bill is very advantageous to the American merchant marine and should be of great assistance in rehabilitating the American flag on the seven seas.

A Splendid Step Toward Building Up of an American Merchant Marine

By Edward N. Hurley

Former chairman United States Shipping Board

The Jones-White bill is a splendid step toward the establishment of an American merchant marine. For about six months before going abroad I worked with President Coolidge in behalf of this legislation. While it does not make up for the difference in cost of building ships here and in foreign shipyards, it does possess features which make it highly acceptable.

The differential in building costs may well be met by the fact that costs will be lightened as our shipyards get more orders, thus distributing their overhead charges. The mail contract feature should be very attractive to purchasers of Shipping Board services. The low interest on loans for construction and reconditioning also should help the private owner.

Considers Bill the Most Constructive Marine Legislation Adopted in Years

By H. B. Walker

President American Steamship Owners Association

The Jones-White act marks a distinct step in the development of the American merchant marine. It is undoubtedly the most constructive piece of marine legislation adopted in years.

The bill is well adapted to present-day competitive conditions and as there are now being operated to all important foreign markets first class American lines, we will soon have nearly all of the United States mail carried under our own flag, and the payments for this service will go far toward building up those lines in the future.

The passage of the merchant marine act, 1928, will go a long way toward making possible the carrying out of the declared policy of the United States. On certain routes plans already are being prepared for the construction of additional tonnage of a faster type than

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that now employed. This will enable Americans to compete with the modern tonnage now being operated on various routes under foreign flags, and will result in a direct benefit to the American manufacturer, merchant and farmer, directly or indirectly interested in foreign trade, and will also materially aid the American shipbuilding industry which at the present time is most urgently in need of new business. It should further result in the sale of a number of lines now operated by the Shipping Board.

Shipping men generally believe that the act indicates that Congress has attained better understanding of the needs of the industry.

Expect to Build New Vessels

By J. E. Dockendorff

President American Diamond Lines

At the present moment we are not contemplating the building of new vessels, but we expect that this matter may be of interest to us at a later date.

Plans for a New Liner Finished

By F. A. Bailey

Secretary Matson Navigation Company

Plans have virtually been finished for a new liner, but the specifications have not been worked out. We will go into the cost of such a vessel, with the intention of building two sister ships of this type, provided the cost is right.

Growth of the Merchant Marine Will Be Gradual on Sound Basis

By Emmet J. McCormack

Treasurer Moore & McCormack Company

The Jones-White bill is wisely designed, to promote slow and permanent development of the merchant marine, based on the requirements of the various trades. Promiscuous building without regard to the requirements of the trades would nullify the purpose of the bill. Existing tonnage should be repaced in due time with faster, modern types of vessels, so that ultimately we will have a strong American merchant marine.

Mail Compensation Beneficial But Will Not Offset Difference in Building Costs

By Harris Livermore

President Coastwise Transportation Corporation

This company does not plan to build any new vessels as a result of the passage of the Jones-White shipping bill.

It seems to us that the mail subsidy features of the bill will be very beneficial to those lines which already exist, such as the Munson Line running to South America, the Dollar Line to the Far East and others, but we confess that we do not see exactly how it will be possible for anybody to build steamers in this country to run in competition with foreign steamers when the disparity in first cost is so great. This disparity exists notwithstanding the provisions which have been made for borrowing money from the government at low rates of interest. The insurance and depreciation must be figured on the increased cost, and this cannot be gotten away from.

It may be that the ability to borrow 75 percent of the cost of the steamer will be an inducement to owners in domestic trade, even though the rate in that case is 5½ percent. It is very likely that the shipyards will get some business from these sources.

As an entering wedge the bill is probably a long step in the right direction, but until some means can be devised to offset, in a large measure, the difference in building costs between the United States and foreign countries, we do not believe that much building will take place for foreign trade.

Considers the Bill a Very Constructive Piece of Legislation

By Captain Eugene E. O'Donnell

President Eastern Steamship Lines, Inc.

We believe that the Jones-White bill is a very constructive piece of legislation and will serve to assist vessels of the American merchant marine.

Great Benefit to the Shipping Business

By John B. Waterman

President Waterman Steamship Corporation

The Jones-White bill, as passed, should be a very great benefit to the shipping business as a whole.

It should unquestionably stimulate interest in construction for certain trade routes and should result in considerable activity among the shipyards, particularly in the matter of repairs and renovations.

Will Stimulate Shipbuilding to Some Extent in Certain Trades

By Theodore E. Ferris

Naval Architect and Marine Engineer

There is no doubt in my mind but that this new law will stimulate shipbuilding to some extent in certain trades that are at present in need of new tonnage, and it will help other steamship lines that will be in need of new vessels in the future.

As to any new tonnage contemplated, I am not at liberty at present to disclose the plans of any of my clients.

Estimating on Large 13- to 16-Knot Cargo Vessels

By Robert Haig

Vice-president Sun Shipbuilding & Dry Dock Company

At present we have under consideration quite a number of large cargo vessels, single and twin screw, speeds varying from 13 to 16 knots, upon which we are estimating on a direct inquiry from shipowners as the result of the enactment of the Jones-White bill.

In my mind there is no reason to doubt that this bill will be a strong factor in placing the shipowners in a stronger position to obtain financial aid for the development of their business.

It is too soon yet to give numbers, types and dimensions of vessels that are being developed, but there is every indication that the ships will be of the highest class and fully up to the requirements developed in cargo boats now building in other parts of the world.

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Effect of the Bill Advantageous

By J. G. Johnson

Vice-president Sinclair Navigation Company

The effect of the Jones-White shipping bill on future American shipping should be advantageous.

Little Help for Tanker Operators

By Robert C. Tuttle

Manager marine department, The Atlantic Refining Company

As the Jones-White bill contains very little help, except the loan feature, for operators of tankers, at this moment we do not anticipate constructing any vessels under its provisions.

Privately Owned American Tonnage Should Increase Considerably

By Frederick A. Dallett

Director Red D Line

All American steamship lines should be greatly benefited by the legislation just passed by the Congress and signed by the President. American tonnage, privately owned and operated, should increase considerably in the next few years.

We believe that all those interested in American shipping are to be congratulated on the passage of the bill.

More Interest Being Shown in the Construction of New Tonnage

By Charles F. Bailey

Engineering director Newport News Shipbuilding and Dry Dock Company

We are much encouraged by the passage and signing of the Jones-White bill. Already more interest is being shown in new tonnage. The greater number of the new ships will naturally be passenger and freight vessels fitted for carrying mail. There is some interest in new oil tonnage but nothing unusual. This building has been retarded due to the increase in oil stocks, causing more or less disorganization.

Southern Yards Look for Repair Work

By James C. Merrill

Vice-President Merrill-Stevens Dry Dock & Repair Company

We believe that the effect of the Jones-White bill will be very good for the future of American shipbuilding and especially repairing.

We have always found in this vicinity that when the shipyards in the North have a great deal of construction work going on, our repair business in the South increases and we believe that as soon as the yards are allowed to start on the construction work as outlined in the shipping bill, the effect will be felt down here.

I do not believe the enactment of the bill will cause any construction work to be started in the South as there are no yards in this section of the country equipped to handle shipbuilding of any great tonnage.

To Build Two New Vessels

By Ira Bronson

President Puget Sound Navigation Company

Our company is contemplating the building of two new vessels but the plans are not far enough advanced to justify giving the data at present.

To Build Ten Barges and Diesel Tug

By Benj. L. Cowles

President Cowles Towing Company, Inc.

I think the Jones-White bill should be a great help to American shipping, both on the coast and inland.

Most of our operation is on the barge canal and Buffalo Harbor, and since the passage of the bill we have arranged to construct a steel Diesel tug boat 75 feet long equipped with a 360 horsepower engine, to cost approximately $60,000.

We are also arranging to build at the Cowles-Lenahan Dry Dock, Inc., of which the Cowles Barge Line is a subsidiary, two fleets of barges for barge canal use, the same to be of steel, 108 feet long, 22 feet beam, 12 feet depth, to carry 20,000 bushels of wheat each. There will be five barges in each fleet so as to lock together with a towing unit in one of the locks of the canal.

The insurance clause in the Jones-White bill should be a great help to American shipping.

It Behooves Shipowners to Sharpen Their Pencils and Begin Figuring

By R. D. Lapham

President American-Hawaiian Steamship Company

Now that the Jones-White Bill has been signed by the President and has become the law of the land, shipowners and others are wondering just what the effect of the bill will be.

The main features of the bill are the construction loan fund and mail contract provisions. The construction loan fund, providing easy money and terms, would not of itself start shipbuilding on any large scale were it not coupled with the mail contract feature.

It is too early to predict how far shipowners will avail themselves of the opportunities offered. The measure of any mail aid is in the last analysis left largely to the Postmaster-General and the Shipping Board. Inasmuch as the bill when passed developed no partisanship opposition, it is fair to assume that it is the wish of the Congress and the country at large to encourage the development of the American merchant marine in the foreign trade and under private ownership.

With that general sentiment so apparent it is expected that the Postmaster-General and the Shipping Board will do all they legally can to accord the shipowner the most favorable treatment and encouragement in the hope that the purposes of the bill will be attained. The bill is a compromise. In many ways it strengthens the powers of the Shipping Board. The provision forbidding the sale of any vessel or line except upon the affirmative vote of five of the seven members of the Shipping Board makes it easier for the Shipping Board to keep the Government in business, if they are so inclined.

On the whole the bill is a step in the right direction. At any rate, it behooves shipowning companies to sharpen their pencils and begin figuring whether the construction of new vessels will prove a reasonably profitable venture for their stockholders.

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The

New Passenger Steamer

Yorktown

Built by the Newport News Shipbuilding & Dry Dock Company for the Chesapeake Steamship Company

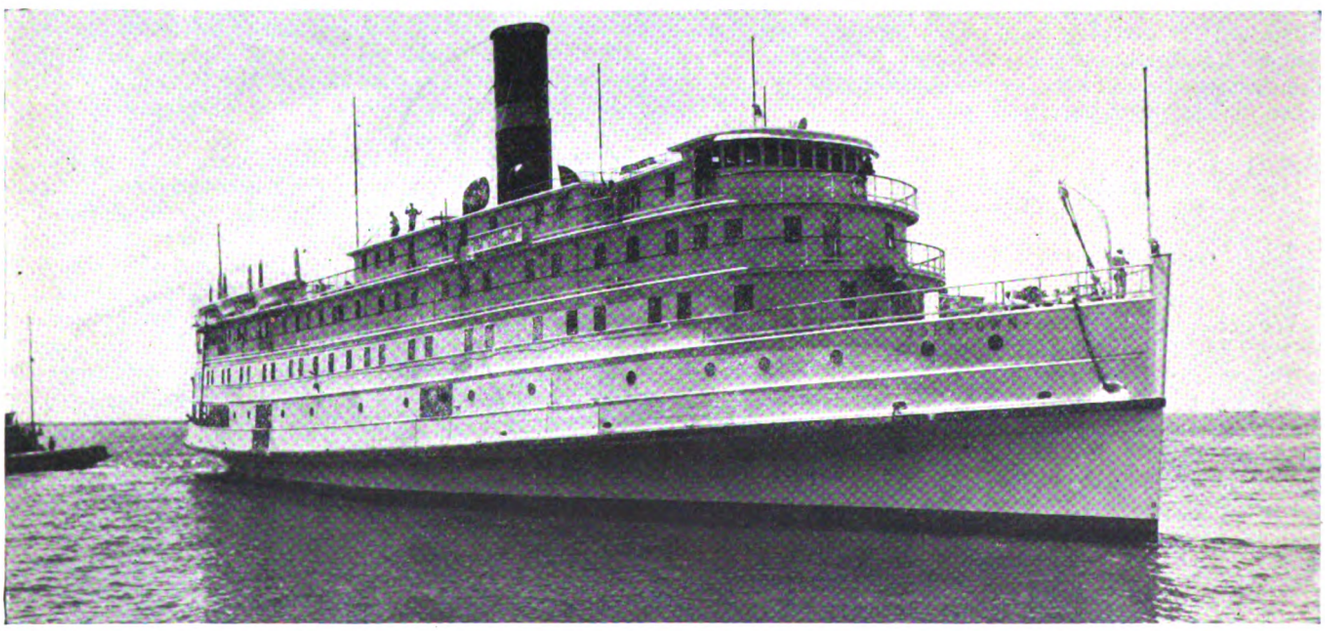
Stern of the Yorktown

THE latest addition to the fleet of the Chesapeake Steamship Company, Baltimore, Md., is the passenger and cargo steamer *Yorktown* built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va. The vessel was launched on February 25, delivered on May 17 and is now being operated on the Baltimore-West Point-Richmond route, stopping at Yorktown, the historical point on the York River from which it received its name. The *Yorktown* is a single screw steel steamer with flared guards and the familiar Cheasapeake Bay type of superstructure, resembling in most particulars the *City of Richmond* now operating on the same run.

The main particulars of the vessel are as follows:

Length overall	277 feet 3 inches
Length between perpendiculars	267 feet
Beam, molded at the waterline	46 feet
Beam over guards	53 feet
Depth molded to main deck	18 feet
Mean load draft	13 feet
Indicated horsepower	2,700
Speed	15½ knots
Total hold cargo capacity	23,950 cubic feet
Total lower 'tween deck cargo capacity	10,250 cubic feet
Total main 'tween deck cargo capacity	35,000 cubic feet
Total cargo space	69,200 cubic feet
Bunker capacity	117.43 tons
Boiler feed water capacity	81.5 tons
Culinary water capacity	37.3 tons
Passenger capacity:	
First class, white	206
First class, colored	26
Second class, colored	98
Total passengers	330
Crew	53

The hull is built on the Isherwood system of longitudinal framing and is classed A-1 under the American Bureau of Shipping rules. The general arrangement and scantlings of the hull are shown in the plans. The bulkheads and outboard facings of the staterooms are of Haskelite 5-ply ⅞-inch thick. The doors of the staterooms are of poplar with Vehisote panels and wire



The new passenger and freight steamer Yorktown

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Looking forward from the stern on the hurricane deck

mesh at the bottom of the doors as a means of ventilation.

The staterooms are comfortable, well heated and lighted and furnished with all the conveniences of a first class hotel. Many have attached bathrooms or showers. All staterooms are supplied with hot and cold running water. The baths also have cold salt water. A number of the rooms are fitted with brass beds, each of which has a berth light, and there are several suites of two rooms with bath between. Each room is equipped with a telephone.

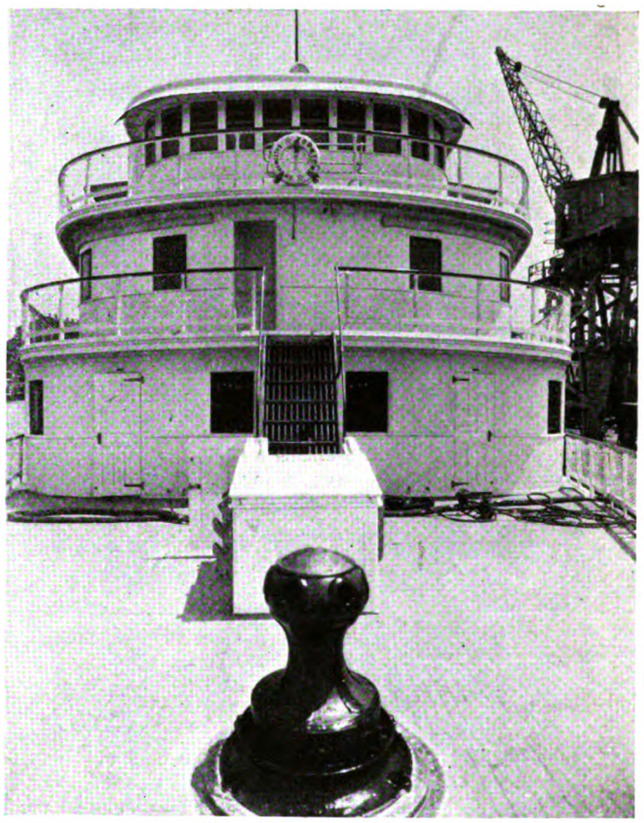
The public spaces are paneled in a uniform design of simple but attractive patterns.

The saloon decks are carpeted and the first class smoking room, dining room and similar spaces are covered with pleasing patterns of Goodyear rubber tiling.

The living quarters are steam heated throughout, American Radiator Company's radiators being fitted in the officers' and crew's quarters and in the outside passenger staterooms, the dining saloon and public rooms.

The dining saloon on the gallery deck forward, with accommodations for 75 persons, is a particularly light and cheerful room. As delicious meals are a feature of the Chesapeake Line the equipment of the galley and dining saloon of the *Yorktown* is designed to maintain the reputation of the line in this respect.

General view of main saloon from gallery deck



Looking aft from the bow on the saloon deck

Deck Machinery

The cargo handling facilities include four elevators, two forward and two aft, each operated by a Bethlehem 7-inch by 7-inch elevator engine with single drum. Forward on the main deck there is a Hyde steam windlass which is connected to a Hyde capstan on the saloon deck above. Another Hyde capstan with cylinders 4½ inches by 6 inches is fitted on the main deck aft.

The steam steering engine, of the Hyde type located on the main deck forward is of the combination steam and hand type with double 7-inch by 7-inch cylinders and is operated by a vertical shaft. A Hyde right and left screw hand auxiliary steering gear is mounted on the saloon deck aft.

The life saving equipment includes six 25-person metallic lifeboats, one 16-foot wooden boat and five A B C life rafts, each with a capacity of 40 persons. The lifeboats are handled by Welin davits.

Electrical Plant

The electric light plant consists of two Engberg reciprocating engines, each direct connected to one Eng-

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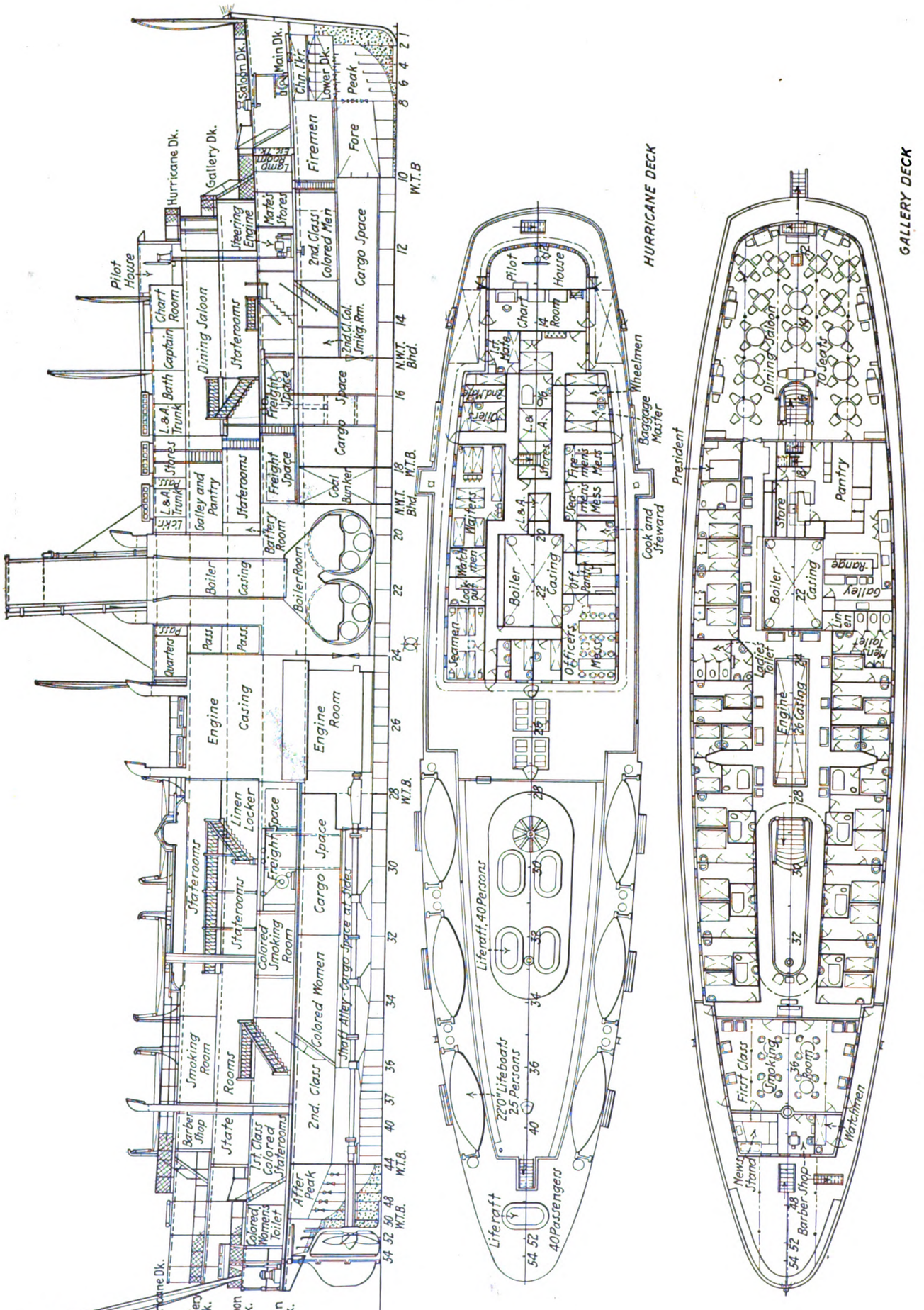

Inboard profile and plans of hurricane and gallery decks

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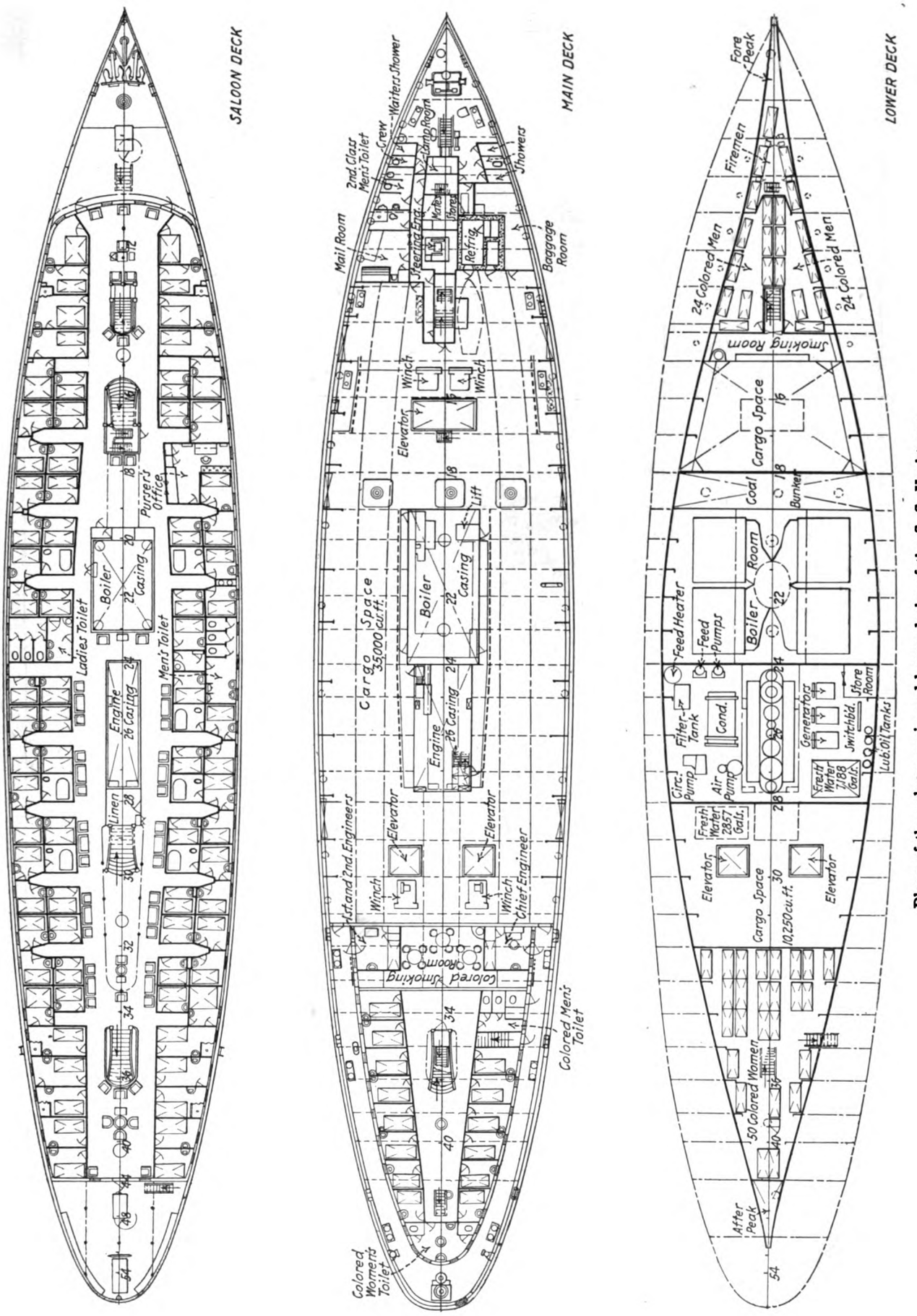

Plans of the saloon, main and lower decks of the S. S. Yorktown

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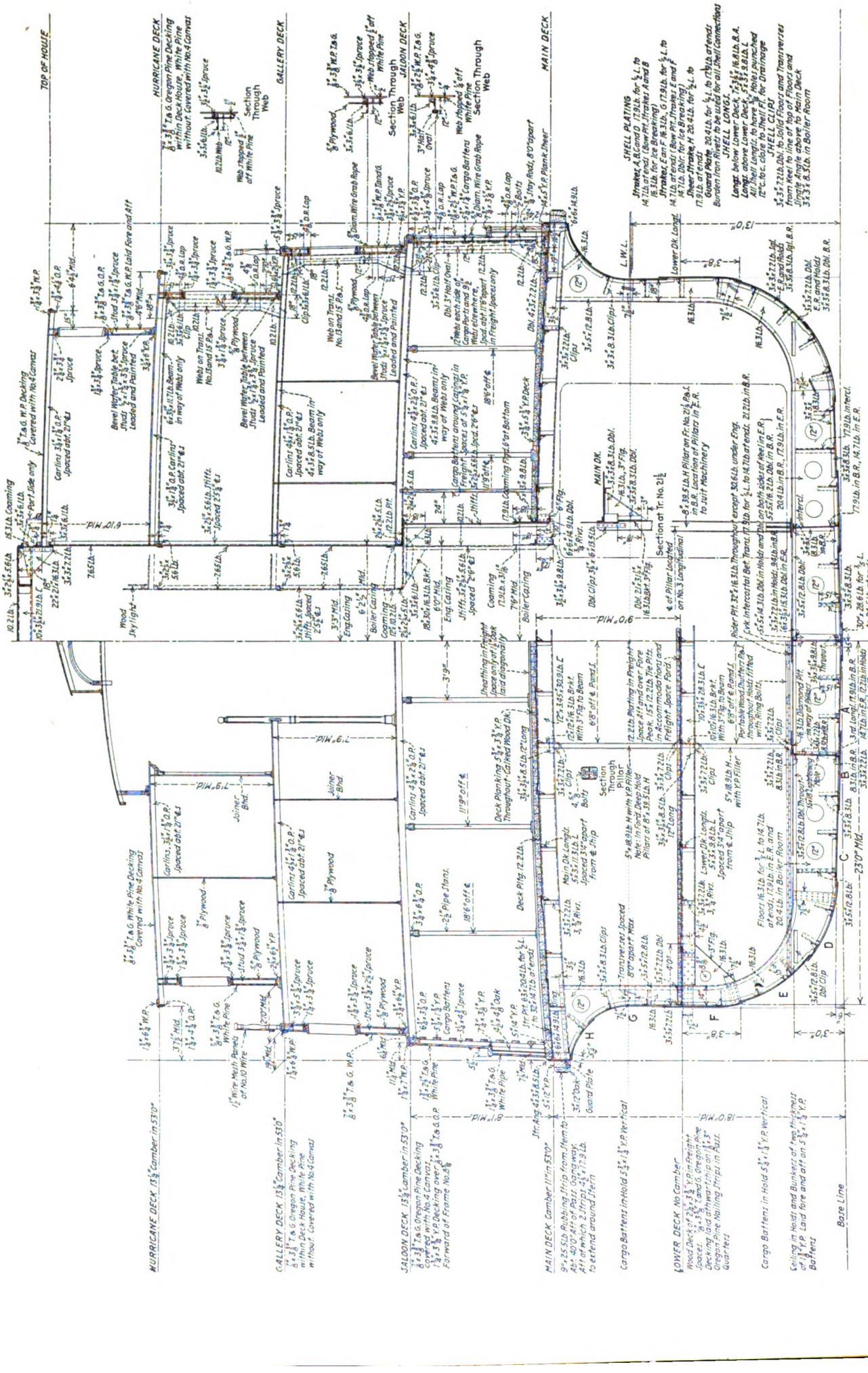

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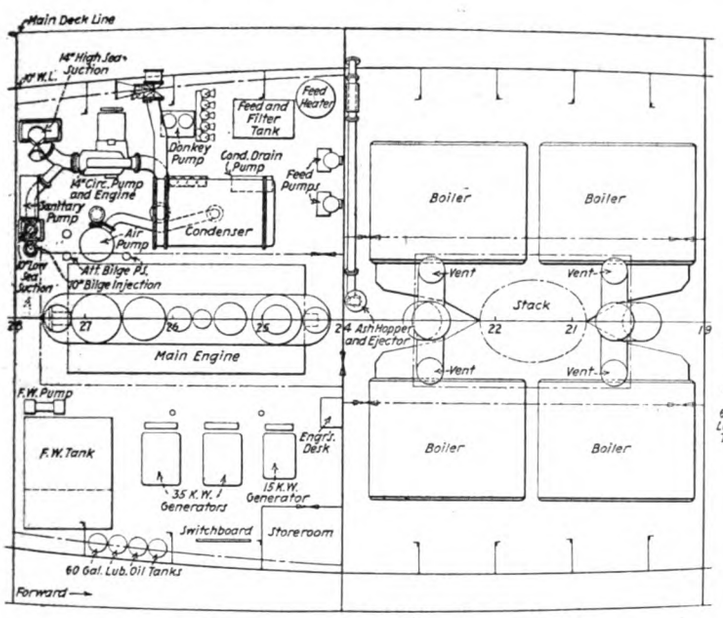
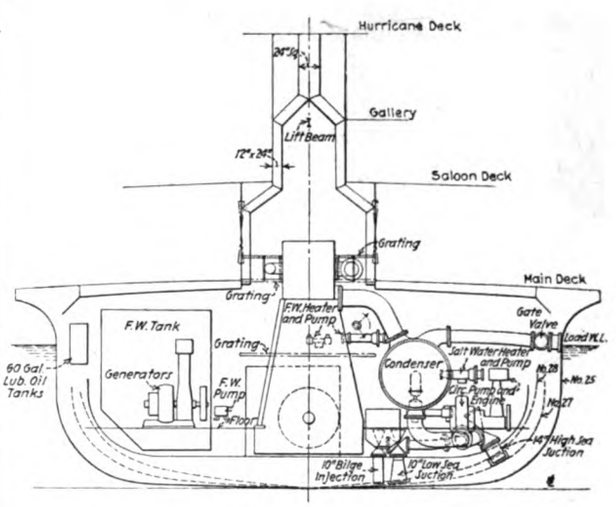
berg generator of 35 kilowatts capacity and one Engberg reciprocating engine direct connected to one Engberg generator of 15 kilowatts capacity. An emergency lighting system with Edison batteries is also installed. A 14-inch 25-ampere Carlisle-Finch searchlight is included in the equipment.

Propelling Machinery

Propulsion is by a solid 4-bladed manganese bronze propeller, 12 feet 6 inches diameter by 15 feet 4 inches pitch, driven by a 4-cylinder triple expansion reciprocating engine with cylinders 23, 39, 47, and 47 inches diameter by 40 inches stroke supplied with steam at 190 pounds per square inch from four 3-furnace single ended coal fired boilers working under natural draft. Each boiler is 14 feet diameter and 11 feet 4 inches long. The engine is designed to develop about 2,700 indicated horsepower. The main condenser is independent of the main engine framing. An Edwards air pump and two bilge pumps, each 5 inches diameter by 16 inches stroke, are attached to the main engine. An independent duplex pump, 6 inches by 5¾ inches by 6 inches is connected to the air pump suction. The thrust block is of the horseshoe type.



Plan of engine and boiler rooms



Section at frame 25, looking aft

Auxiliaries

The engine room auxiliaries include the following:

1 Reilly multicoil feed water heater
1 centrifugal circulating pump driven by an independent 8-inch by 10-inch engine
2 Warren vertical simplex main feed pumps; stroke, 24 inches.
1 Warren vertical duplex donkey pump, 12 inches by 7 inches by 12 inches
1 Warren horizontal duplex sanitary pump, 6 inches by 7½ inches by 6 inches
1 Warren horizontal duplex fresh water pump, 5¼ inches by 4¾ inches by 5 inches
2 2½-inch Koerting double tube injectors
1 hydraulic ash ejector

The *Yorktown* will carry out the best traditions of the "New Bay Line" in providing all that can be desired for the comfort and safety of the passengers and it is safe to say that that handsome new vessel will serve to further increase the popularity of the Richmond-Baltimore service of the Chesapeake Steamship Company.

Rules Governing Storage of Fuel Oil at Panama Canal

THE regulations governing the storage of fuel oil, Diesel oil, gasoline, and kerosene at Panama Canal terminals, issued March 9, 1923, have been superseded by revised rules issued under date of March 28, 1928, which have been printed and distributed to all concerned. The principal changes are with respect to fire protection measures and the viscosity limit. The new fire protection measures are those which were adopted at a conference with the representatives of tank owners, held on January 16, 1928, and are based upon recommendations made by a committee appointed by the Governor to investigate and report on this subject.

The viscosity limit has been changed from 300 seconds at 122 degrees F. to 1,100 seconds at 86 degrees F., to conform with established practice at the Canal pumping plants. The normal working temperature at the Canal plants is 86 degrees F., and as the plants have no way of heating oil to 122 degrees F., it was decided to establish the limit on the basis of actual conditions at the plants. It has occurred that oils meeting the specification test at 122 degrees F. were entirely too heavy for proper pumping at 86 degrees F. Provision is made that a higher pumping charge may be assessed if heavier oils are brought to the Canal plants for storage. Some other minor changes were made to bring the rules up to date.

Hull Line Experiments Approved

SELF-PROPELLED model tests with models fashioned after vessels which it is proposed to convert to Diesel propulsion will be undertaken by the Shipping Board in cooperation with the Navy Department following action of the board on June 19. The tests will be designed to ascertain possible increases in speed of ships through alterations in design as well as through substitution of Diesel engines for their present steam engines.

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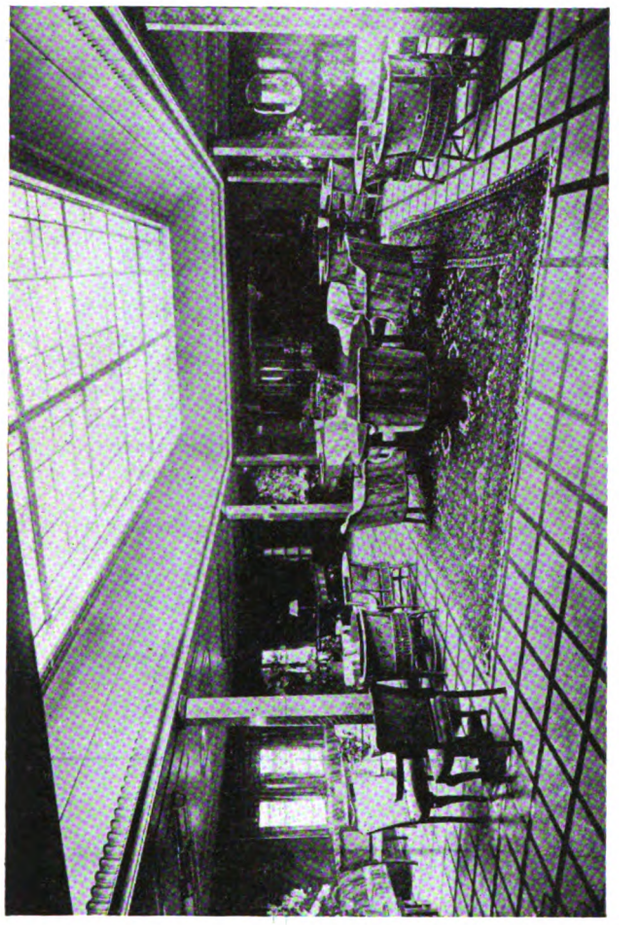
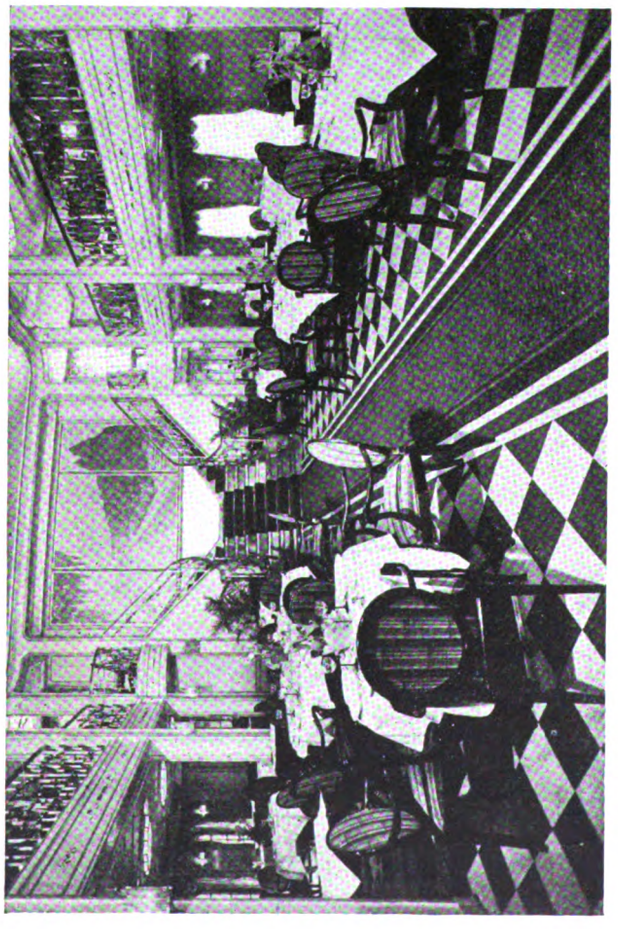
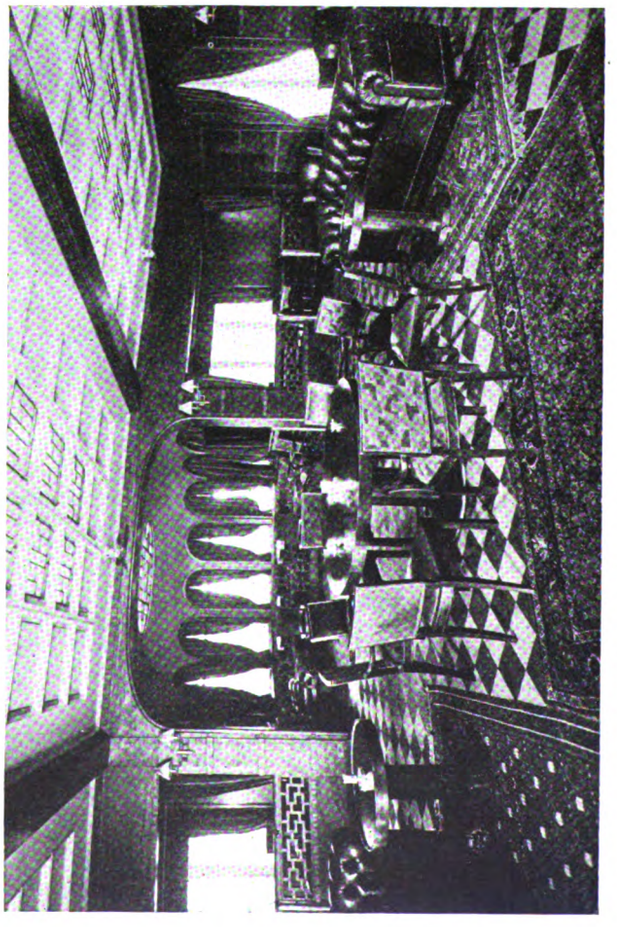


First-class lounge, M. S. Orinoco

Intermediate-class dining room, M. S. Orinoco



First-class dining room, M. S. Orinoco



First-class smoking room, M. S. Orinoco

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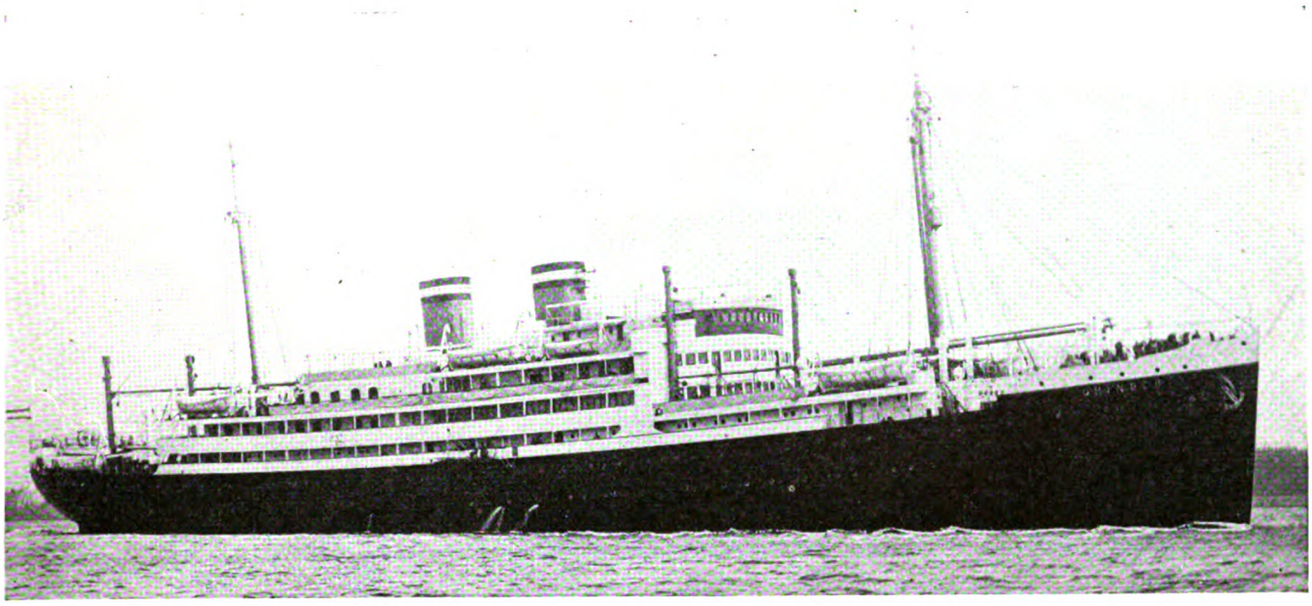


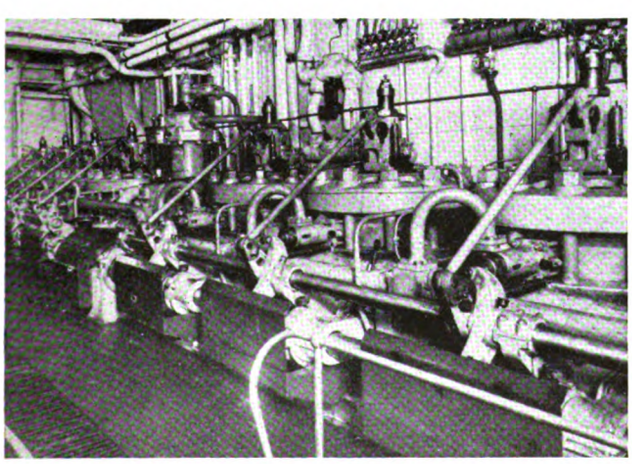
The Hapag liner Orinoco, built especially for service to the West Indies

European-Central American Services

New 14 to 15-knot German and Italian motor vessels placed in passenger and cargo service

By Our London Correspondent

SHIPOWNERS with vessels trading between European ports, the West Indies and Central America, have, in some cases, latterly been renewing their tonnage, and the unanimity with which internal combustion machinery has been adopted in the place of steam plant seems to indicate that there are special advantages accruing from the employment of Diesel motors in ships engaged in certain trades. The reason is, no doubt, that the voyages involved are fairly lengthy, and that steamers using coal must bunker at Central American or West Indian ports where coal is not at its cheapest, whereas liquid fuel at some of these ports is to be purchased at a relatively low price. The motorship can take on sufficient oil for a round voyage back to Europe and out again to the West Indies or Central America. The result is that it is considered that the average price paid for oil is not more than double that of coal, with the consequence that the motorship effects a very substantial saving in the fuel bill.



One of the new type of M. A. N. single-acting engines in the Orinoco

Again, its facility to bunker a large quantity of fuel in double bottom tanks enables a motorship to be built of a higher speed than would be possible with a steamer without detracting considerably from the cargo carrying capacity owing to the necessity for a large bunker space.

The result is seen in the latest passenger and cargo liner which the Hamburg Amerika Line has constructed for this trade, the *Orinoco*, for she is the fastest ship engaged on the service, being capable of 15½ knots at sea, or 15 knots for a complete round trip, making all allowances. This speed is attained in a vessel of 9,500 tons gross with a total daily fuel consumption of 30 to 33 tons, and nearly 1,500 tons of oil can be carried, partly in double bottom tanks and partly in cross bunkers forward of the engine room. For equal radius of action, the steamer would be required to carry between 4,500 and 5,500 tons of coal, which would be an impracticable proposition.

Before giving details of this vessel, which recently started on her maiden voyage and will be joined in the summer by a sister ship, the *Magdalena*, mention may be made of other new passenger-cargo liners built for trade to Central America and the West Indies. The most important of these are the *Orazio* and *Virgilio*, the former built last year and the latter recently completed, both owned by the Navigazione Generale Italiana, and built specially for service between Genoa, Central America and the West Coast of South America. They are somewhat larger and slower than the *Orinoco*

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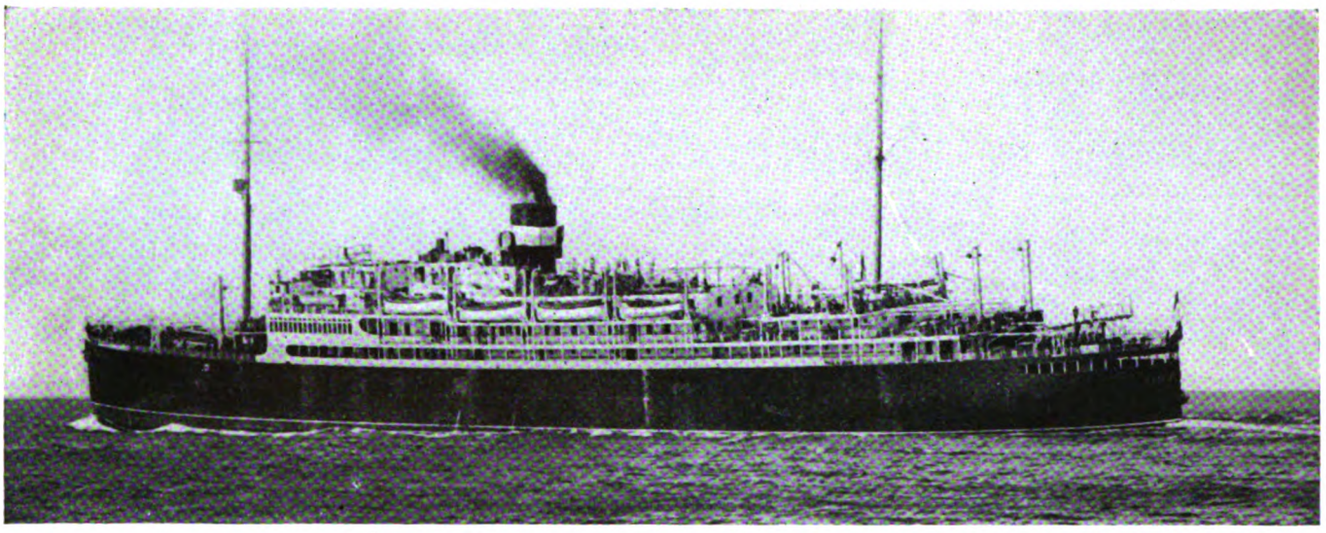

The Navagazione Generale Italiana's motor liner Orazio

and her sister ship, being designed for about 14 knots.

Of another class of passenger and cargo vessel, operating between Hamburg, Antwerp and the West Indies, the *Ingrid Horn* is the first of four sister ships for the H. C. Horn Line, Flensburg, and she has just been completed, while the other three are to be placed in service this year. Thus, eight different types, all equipped with internal combustion machinery, will have been commissioned for this trade within a period of slightly over 12 months. The *Ingrid Horn* is quite a small vessel of 4,400 tons gross, and she has a service speed of 13 to 13½ knots.

As there is a certain similarity between the Hapag *Orinoco*, and the N.G.I. *Orazio* and the sister ship, the following comparative details are of some interest:

	Orinoco	*Virgilio*
Length overall	480 feet	503 feet
Length between perpendiculars	456 feet 8 inches	480 feet
Beam	61 feet	62 feet
Gross tonnage	9,500	11,500
Loaded speed	15½ knots	14 knots
Brake horsepower	6,600	6,600 tons
Cargo capacity	8,200 tons	6,500 tons
Passenger accommodations:		
First class	140	110
Second class	100	190
Third class	100	340

It is unnecessary to describe the passenger accommodations on these ships except to say that they conform with the luxury demanded by travellers on all routes, and, in each ship, numerous cabins are provided with bathrooms attached, while the vessels have the now necessary swimming pool.

Machinery Innovations

The machinery of the *Orinoco* is of a new type, although the sister ship, the *Magdalena*, has normal Sulzer engines. In the *Orinoco* are two M.A.N. motors, but instead of adopting the double-acting, two-stroke design which is being fitted on the large majority of the big fleet of Hapag passenger and cargo liners under construction, the two-stroke, single-acting type has been used. Practically no more engines of this class are now being built, although it may be remarked that the biggest tanker in the world, the *C.O. Stillman*, which was recently constructed, has machinery of a similar design.

There are two engines with eight cylinders, 700 millimeters bore and a piston stroke of 1,200 millimeters, each developing 3,000 to 3,300 brake horsepower at 90 to 95 revolutions per minute respectively. There is a centrally arranged air compressor, but the scavenging pumps are detached from the engine and are of the rotary type, being driven by 150 brake horsepower electric motors. In each cylinder cover, there is only a relief valve and a fuel valve, placed centrally; the starting air valve is horizontal.

Two other novelties are to be found in the installation. One is the employment of a horizontal exhaust gas boiler for raising such steam as is needed while the vessel is under way. The reason this is noteworthy is that, with the low temperature of the exhaust gases of two-cycle machinery, it is unusual to provide an exhaust heated boiler, although this arrangement is now becoming almost general with four-cycle engined ships. The employment of airless injection engines for driving the dynamos is also a feature of interest, for these are comparatively large units of about 320 brake horsepower. They are six-cylinder, M.A.N., four-cycle, single-acting engines driving 220-kilowatt dynamos and running at the relatively high speed of 300 to 325 revolutions per minute.

Supercharged Engines

On the *Orazio* and *Virgilio*, on the other hand, four-cycle, single-acting plant of the standard Burmeister & Wain type, built in Italy, is installed. As was the case with the *Saturnia*, however, in order to attain the maximum power possible, supercharging is adopted, with the result that the two vessels in question are the highest-powered, four-cycle, single-acting engined ships afloat.

There are two engines of 740 millimeters cylinder bore with a piston stroke of 1,500 millimeters and each engine has eight cylinders, the speed being 120 revolutions per minute. In the ordinary way, such an engine would develop 3,000 brake horsepower with a permissible mean indicated pressure, but the output needed was 3,300 brake horsepower. Consequently, electrically-driven supercharging blowers are installed, which enable an additional 10 percent to be attained without any serious increase in temperatures within the cylinder or in maximum pressures. Those engineers who disapprove of the adoption of supercharging may note with interest that in the two 15-knot cargo liners which the Blue Funnel Line has just ordered in England, and which have machinery similar to that of the *Orazio* and *Virgilio*, supercharging will be adopted as a result of the experience gained in similar vessels.

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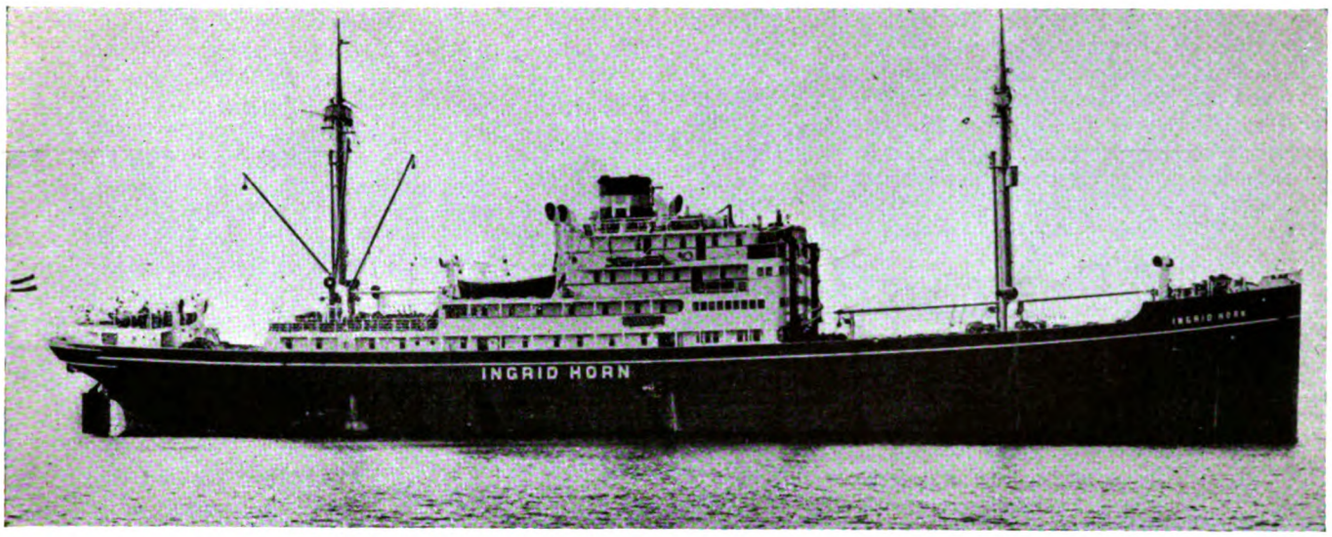

The Ingrid Horn, one of four sister ships

A Five-Cylinder Engine

The machinery of the *Ingrid Horn,* is also worthy of a brief description. It involves the employment of a five-cylinder unit, which is rather unusual, and, in fact, an alteration was made after the vessel had been ordered as it was considered that higher speeds were necessary than had originally been thought desirable.

It is a Sulzer standard design with cylinders 680 millimeters bore, and a piston stroke of 1,200 millimeters, the output being 2,800 brake horsepower, at 105 revolutions per minute.

It drives a scavenging blower on the crank shaft, but this is taken out of operation on long trips and the air supplied from an electrically-driven blower, thus adding somewhat to the engine output and the vessel's speed. One reason for the employment of this apparently unnecessary duplication is that the Germanischer Lloyd demands that there shall be alternative supplies for scavenging air in single-screw, two-cycle engined ships, although the British Lloyd does not ask for this, but requires the single scavenging blower to be equipped with electric motors, one on each side.

The *Ingrid Horn* has accommodations for 40 people, and a music saloon and smoking room are provided, giving a noteworthy degree of comfort in a vessel of such relatively small size. Incidentally, the owners, the H. C. Horn Line, of Flensburg, are operating six other motor ships on the same trade, but they are 11-knot vessels, so that, by the end of the year, they will have 11 motorships trading to the West Indies.

Activity In French Shipyards

THE Société des Services Contractuels des Messageries Maritimes has recently placed an order with Ateliers et Chantiers de la Loire for the construction at Saint Nazaire of a motor passenger liner to be named the *Felix Roussel.* This vessel will be operated in the China-Japan service of the company. She will have a displacement of about 21,000 tons, a length of 560 feet overall, a breadth of 68 3 feet and a depth of 47 feet. Accommodations will be provided for 1,067 passengers. The propelling machinery will consist of two Sulzer 2-cycle, 8-cylinder Diesel engines, together developing 14,000 indicated horsepower. In addition there will be five Sulzer auxiliary Diesel engines installed, each driving a 325-kilowatt generator. These engines are under contract with the Compagnie de Construction Mécanique Procédés Sulzer, Paris. The service speed of the *Felix Roussel* will be about 16 knots.

A short time ago the largest French tanker ever built, the *Rhéa,* of 10,600 tons deadweight, was launched at Bordeaux. This vessel was built by the Ateliers et Chantiers Maritimes du Sud-Ouest for the Cie Auxiliaire de Navigation. She is fitted with two Burmeister & Wain Diesel engines, as was also her sister ship, the *Roxane.*

It is interesting to note at this time that the French tanker fleet, which was practically non-existent at the end of the war, will aggregate nearly 300,000 tons deadweight by the close of the year 1928.

Among foreign orders nearing completion in French shipyards is the tanker *Orkanger,* which was launched May 20 at the Ateliers et Chantiers de la Seine Maritime. This vessel, which is for a Norwegian firm, is fitted with one Schneider Company, Burmeister & Wain, Diesel engine of 4,250 indicated horsepower.

Foreign Ship Construction

At present a number of French shipyards are depending almost entirely on construction placed by foreign shipping companies. However, when these ships are completed foreign orders will probably stop for a while, owing to the revaluation of the monetary standards by the French government. Foreign naval orders, however, are still obtainable.

In this connection, a number of French shipbuilders are engaged with the construction of submarines and destroyers for Greece, Poland and Jugoslavia. About two months ago the Greek submarine *Triton* was launched from the Nantes yard of the Ateliers et Chantiers de la Loire while the sister ship *Glafkos* was launched quite recently from the Blainville yard of the Chantiers Navals Francais.

Recent contracts from the French navy have aided greatly in supporting many French shipbuilders who have experienced a considerable decline in orders from private shipowners. In connection with naval construction, the record speed of 36.15 knots attained by the new 10,000-ton cruiser *Tourville* is of considerable interest. This cruiser is propelled by four Rateau turbines developing 130,000 horsepower. The machinery for this

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vessel was designed and constructed by the Ateliers et Chantiers de Bretagne.

There is considerable speculation among the shipbuilders and shipowners as to whether or not the Senate will ratify the draft bill providing for the maritime credit system of loans to shipowners for building new vessels, which was approved in March by the Chamber of Deputies.

$21,000 Demurrage Charges Saved on M. S. Childar

By R. P. Morgan

THE United States Government maintains a first-class repair shop and dry dock at the Pacific entrance to the Panama Canal at Balboa. Ships in transit or in the vicinity have the benefit of these shops in an emergency, and it is our duty to expedite the work as quickly as possible to save demurrage charges, which are very high when both ship and cargo are being held up.

A recent engineering problem handled at these shops was on the motorship *Childar*, owned by the Wiel Amunsden Company. When this ship was about 600 miles out, she broke her main engine air compressor. The *Childar* is propelled by a four-cycle, full-Diesel, air spray, fuel injection engine, and it is necessary to have 1,000 pounds per square inch pressure at all times the main engine is running. While the auxiliaries could supply the proper pressure, they did not have sufficient volume to keep the main engine going, except at a very slow speed.

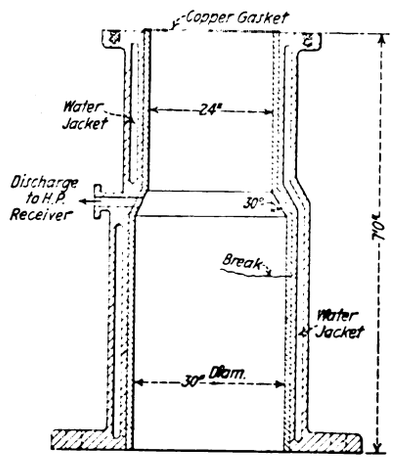
Details of Compressor

The main compressor has three pressure stages. The low and intermediate pressure cylinders are in one casting, and the high pressure cylinder is bolted to the top of the intermediate. The low and intermediate pressure pistons are made from one casting, and the high pressure piston is secured to top of the intermediate piston by means of a steel stud of special material. On top of the high pressure piston is a steel plug that is provided with a tapped hole for an eye-bolt for the purpose of lifting the compressor pistons when handling or working on the bearings of the connecting rod below. The steel plug worked loose and became unscrewed far enough to strike the high pressure cover. When this occurred, the piston, being of the trunk type, was forced outward causing a circumferential crack about 6 inches from top of the low pressure cylinder between the water service jacket and the compressed air space.

The broken cylinder was a casting approximately 7 feet long, water-jacketed over the entire length. The bore of the bottom or low pressure cylinder was approximately 30 inches and of the top or intermediate cylinder approximately 24 inches. To make a pattern with water jacket cores, etc., for this, would have been a very long and expensive job, especially on account of the ship's demurrage, so it was decided to bore the cylinder and install a liner the entire length of the low and intermediate cylinders. The cylinder walls being approximately 1¼ inches thick, the diameter was bored out 1½ inches, making the thickness of the liner approximately ¾ inch.

The installation of the liner was difficult because the discharge port from the intermediate to the high pressure cylinder was on an angle at the point where the low pressure cylinder was reduced to the intermediate pressure cylinder. The pressure at this stage is approximately 375 pounds per square inch.

The first operation was to rough bore the cylinders. The crack, which was about 14 inches long before starting to bore, extended over half the circumference of the cylinder. After the diameter was bored out 1½ inches, this crack was sewed with a series of copper plugs, the cylinder put back on the machine and a finishing cut taken through the cylinder. While this work was in progress, a liner was cast by the loom mold process, and rough bored and finished outside to the exact size of the bore of the cylinder.



Section through intermediate and low pressure compressor cylinders, showing location of crack

Great care was taken that no oil got on the cylinder or liner before pressing the liner into the cylinder. A thin layer of manganasite was placed on the bevel and then the liner was pressed into the cylinder with about 50 tons hydraulic pressure. Fearing that the crack had opened up again when pressing in the liner, we filled the water jacket with water containing sal-ammoniac, and blanked it off, then put the cylinder back on the machine and finished boring it.

When the cylinder was installed on the ship, a copper gasket was placed between the top of the liner and the high pressure cylinder, in order to hold the liner securely in place. A radio received from the master of the *Childar* about three months after these repairs had been effected stated that the compressor was working perfectly. Owing to the time saved by handling the work in this manner, the shipowners saved at least $21,000 on demurrage.

Welded Bilge Keels

WELDED bilge keels were approved for the second Panama Pacific steamer, under construction at the yards of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., as a result of the following relative estimated savings in weight and cost of these keels as compared with the riveted keels which would have been used:

Savings in weight	30 percent
Savings in cost of material	35.5 percent
Savings in labor and overhead	21 percent
Total savings	28.5 percent

These savings were principally effected by the substitution of a flat bar welded to the shell for the usual riveted tee-bar connections. In other respects the keels are identical except that all joints are welded instead of being riveted.

Four naval ships including the aeroplane carrier *Langley* were equipped about eight years ago with welded bilge keels at this yard.

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The Present Position of the Question of Fuel for Ships*

By Sir John H. Biles

LLOYD'S Register reports that at the end of June, 1927, and of June of each of the two preceding years the relative state of the three types of machinery: (1) coal fired, (2) oil fired, (3) oil engines, was as follows:

GROSS TONNAGE OF CLASSED NEW VESSELS LAUNCHED UP TO JUNE 30 IN EACH YEAR

	Steam					
Year	Reciprocating	Turbine	Total Steam	Coal Fired	Oil Fired	Oil Engines
1925	894,807	114,009	1,008,816	671,405	337,411	302,451
1926	575,984	146,354	722,338	418,503	303,835	602,451
1927	405,280	168,557	573,837	297,948	275,889	393,225

GROSS TONNAGE AFLOAT UP TO JUNE 30 IN EACH YEAR

	Steam					
Year	Reciprocating	Turbine	Total Steam	Coal Fired	Oil Fired	Oil Engines
1925	50,566,029	9,100,274	59,666,303	41,862,181	17,804,122	2,714,073
1926	50,040,978	9,137,675	59,178,653	40,935,144	18,243,539	3,493,284
1927	49,767,495	9,228,983	58,996,478	40,514,719	18,481,759	4,270,824

In three years there has been a falling off of 1.6 percent in tonnage of ships having reciprocating, and an increase of 1.4 percent in turbine and 57 percent in oil engine ships. During these three years the new ships launched have changed as follows: reciprocating reduced 55 percent, turbines increased 48 percent, oil engines increased 30 percent. The total new tonnage of coal-burning ships built has decreased 55 percent, the oil-using ships have increased 4½ percent, the total new tonnage built having decreased 26 percent.

The use of the watertube boiler was looked upon with suspicion three years ago. Since then the *King George V* has been built, fitted with 550-pound pressure boilers, coal fired, and has been running successfully for a whole season. Mr. John Johnson, superintending engineer of the Canadian Pacific Steamships, has had the courage to recommend, and the good fortune to secure, the adoption of watertube, coal-fired boilers of 250 pounds pressure in connection with Parsons turbines, and these installations have been successfully running in the *Beaverburn,* and other similar ships. Other ships of this line are to be fitted with turbines of 20,000 shaft horsepower, watertube boilers, oil fired, 370 pounds pressure and 250 degrees superheat. Mr. Visker, superintending engineer of the Nederland Stoomvaart Maatschappij, has applied high pressure steam to a triple engine. The boiler pressure is 500 pounds superheated to 750 degrees. With mechanical stokers the consumption is 1.13 pounds per indicated horsepower for all purposes. The *Ile de France* has 52,000 shaft horsepower, and has Howden boilers, which are mixed firetube and watertube boilers. It is claimed that they have 10 percent more efficiency than a cylindrical boiler. The S. S. *California* has about 14,000 shaft horsepower with watertube boilers working at 275 pounds pressure and 120 degrees superheat. The P. & O. are reputed to have given a lead to the ocean-going ships of this country by adopting electric transmission instead of mechanical between the steam engine and the propeller shaft. This machinery consists of watertube boilers of 400 pounds pressure driving steam turbo-electric generators of high revolutions. In the Bauer-Wach system of using a low pressure turbine geared to a triple engine a gain of 20 percent of economy has been claimed, and the system has been adopted in many triple ships. The Germans are reported to be building two new *Aquitanias* having watertube boilers of 350 pounds pressure with turbine machinery. One firm of watertube boiler makers has fitted forty-two sea-going vessels during the last three years with over 120 boilers.

As it has been my lot previously to point out that the real question is what it costs to produce the shaft horsepower necessary to propel a vessel, you will perhaps, forgive my repeating this as a reminder, and to give the figures in the next paragraph as an illustration.

In an oil engine we may assume that one shaft horsepower can be got for not less than 0.4 pound of oil per hour, and that with oil at £4 per ton, 1 pound of oil will cost 0.43 of a penny, so that one shaft horsepower costs 0.17 of a penny per hour for fuel oil. Assuming that the ordinary reciprocating engine with cylindrical boilers of 200 pounds pressure requires 1.7 pounds of coal per shaft horsepower per hour, and that coal is 24s. per ton, then 1 pound of coal will cost 0.13 of a penny, and one shaft horsepower will cost 0.22 of a penny. We may assume that the oil engine costs at least £22 per shaft horsepower in this country, and the ordinary triple expansion costs £10 per shaft horsepower and that each works 200 days per year, and that the total annual charges are spread over these 200 days. The depreciation, interest, and insurance per hour works out at 0.09d. per shaft horsepower hour for the triple, and 0.2d. for the oil engine. Fig. 1 shows the price that coal should be per ton for any price per ton of oil, in

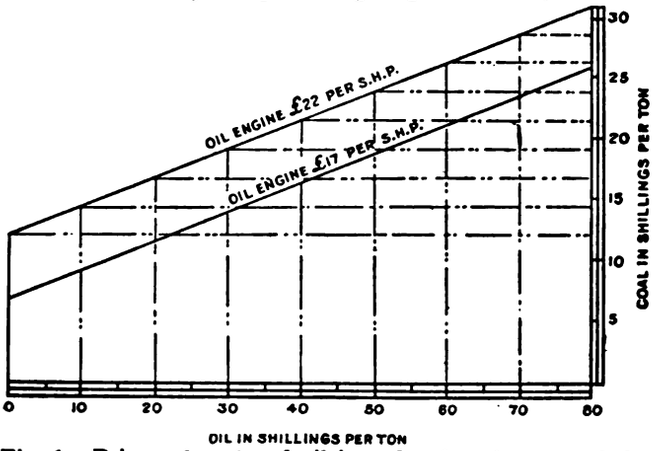

Fig. 1.—Prices of coal and oil in order that the sum of the cost of coal and charges based on first cost of machinery shall be equal to the sum of the cost of oil and charges

* Paper read at the spring meetings of the sixty-ninth session of the Institution of Naval Architects, London, March 28, 1928.

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order that the sum of the cost of fuel and the interest, depreciation and insurance on the first cost of the machinery shall be the same. If oil is presented "free gratis, and for nothing," to the oil shipowner, the coal burning shipowner can afford to pay 12s. per ton for his coal, and still his fuel and charges will cost no more than those of the oil engine. With oil at the standard price of 80s. the figure for coal may be 30s. With oil at 30s. the corresponding figure for coal may be 19s.

These two items, fuel and 18½ percent for charges, do not constitute the whole of the costs. The total costs were dealt with very fully in my two earlier papers, but the masses of figures there involved do not lend themselves to ready and easy discussion. Further, the *difference* between the H.P.T. and the oil engine in the cost of the other items dealt with, viz., lubricating oil, wages, food, and fresh water, amounts to about 1 percent of the total cost in favor of the oil engine. This quantity, about £350, may be kept in view in the estimate of total cost of running, but an effective comparison between the most efficient steam and oil engines can be made without it (see Table III.).

The triple expansion engine, with the dirt of its coal and the hard work of its firemen, does not compare in ease and comfort at sea with either the oil fired boilers and the turbine or with the oil engine. The liquid nature of oil causes it to be more easily handled both in port and at sea. Shorter time in port, and consequent greater profits, where profits can be made, and smaller machinery crews are the results. These advantages may be very considerable, especially in the case of periodic services, where a quicker turn round may enable a schedule to be maintained with a smaller number of ships. It is not easy to evaluate this advantage in terms of cost of running per shaft horsepower between services which are coal burning and oil burning respectively, but it is evident that where reductions in the nature of 25 percent in the number of ships employed to do a given service are made by the use of oil instead of coal such use is fully justified.

The question arises: What is the best form of machinery in which to use the oil; second, can any means be adopted to make coal so liquid that the advantages stated above can be as readily obtained as with oil.

It may first be remarked that in similar machinery supplied by steam from boilers, coal fired, as compared with oil fired, the relative B.t.u's of the oil and the coal measure the quantity of fuel used and the amount of boiler power necessary. Assuming the relative B.t.u's to be 13,600 and 19,000, it is evident that the oil firing is more costly when the cost per ton of oil is more than 1.4 times the cost of coal. That is, oil must be not more than 28s. per ton to compete with coal at 20s. per ton.

There is some advantage in the oil fired installation, as the weight and space occupied may be $\frac{1}{1.4}$ times that of the coal fired, i.e., about 28 percent of the boiler space, fuel and weight may be saved.

In the case of an intermediate passenger turbine steamer, 550 feet long, having 10,000 shaft horsepower with cylindrical oil-fired boilers (200 degrees superheat), in order to do the same work with coal firing it will be necessary to carry extra boiler power and to have extra coal space, and to do so it will be necessary to increase the length of the ship 46 feet if the other dimensions are not altered. A typical Atlantic vessel of this size would carry about 1,650 tons of oil, and if enlarged to use coal instead of oil would require about 2,300 tons of bunker space to steam the same distance. The extra weight of hull, boilers and coal would be about 2,100 tons. If the displacement is enlarged in proportion to the length, the increase will be 1,900 tons. If we put it all in amidships, it would be 2,400 tons, so that it seems to be quite a practicable proposition by increasing the length of the ship to carry the same weight of cargo, stores, etc., and sufficient coal to steam the same distance as the shorter ship could steam when burning oil. The net result is that the ship would be increased 46 feet in length and would cost about £70,000 more. The difference between the cost of the coal and oil per year in the two cases would be about £35,000, while the charges on the extra cost of the ship would be about £14,000, so that the coal-burning ship is £21,000 per year better than the oil-burning ship. Therefore, the whole economic advantage of burning oil in this type of ship depends on the ease with which the oil can be put on board, and used on board.

So much for the comparison between coal burning and oil burning for ships with cylindrical boilers, ordinary turbines and 200 degrees superheat. The next comparison may be made between steam machinery using coal or oil and the oil engine. Table I gives ample opportunities of studying this question.

First, we may take the *King George V*, which has passed the experimental stage of the use of steam of 550 pounds pressure and 700 degrees of temperature and the consequent use of watertube boilers. The consumption of coal of 13,880 B.t.u's has been proved to be 1.085 pounds per shaft horsepower hour. In the turbine one shaft horsepower was produced for 8 pounds of water evaporated, and the auxiliaries required 1.66 pounds. The efficiency of the boilers was 79 percent. The figure 1.085 pounds per shaft horsepower hour may be converted to one in which oil of 19,000 B.t.u's is used, and will be equivalent to not more than 0.79 pound of oil in a plant of 3,600 shaft horsepower. Of this oil consumption, 0.65 pound is due to the turbine and 0.14 to the auxiliaries. In the *King George V*, in which the above figures were obtained, the coal was hand-fired.

Mechanical grates have been adopted in some recently built vessels; but whether the exact value of these grates in terms of coal per shaft horsepower has been accurately determined and can be made known may perhaps come out in the discussion.

There seems to be a prevalent opinion that, to obtain the highest efficiency in a boiler, the air heating must not be limited to the extent that it has to be with mechanical grates, and therefore that for the highest boiler efficiency fuel must not be burnt on a grate but in a pulverized condition.

Can any approach in ease of handling coal be made to that of oil? The changes that have to be made from existing practice are first in getting the coal on board and second in causing it to reach the furnaces in a steady stream. Captain Brand, in his paper read at our last summer meeting in Cambridge, proposed to supply the ships with low temperature distillation residue in a powdered form through pipes, suggesting precautions in bunkering to reduce the chance of explosion of the powdered fuel. Others have proposed supplying the fuel in a small enough size to enable it to be pumped to the bunkers, from which it would be man-handled or machine-conveyed to crushers, and from there to pulverizers, from which it is blown, suitably mixed with air, into the furnaces and there burnt. This latter method of burning has been used freely in the United States, and to some extent in this country. The report

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of the U. S. A. Prime Movers Committee for 1926-7 shows that 203 power stations using powdered coal with boilers larger than 5,000 square feet, say 2,000 horsepower, are in operation.

In this country there appear to be no published figures of a similar character; but it may be remarked that the Electricity Board have authorized 775.000 kilowatts, say 1,000,000 horsepower, of new or extended power stations during 1926-27. A great part of this power is to be developed by pulverized coal, and practically all by watertube boilers.

The following figures, taken from *Power Plant Engineering*, December 15, 1927, give a characteristic record of progress in a particular plant in the U.S.A.:

1902	Scotch boilers	Hand fired	15,000 lb. steam per hour each
1908	Watertube boilers	With chain grate stokers	23,000 lb. steam per hour each
1916	Watertube boilers	Underfeed stokers	33.000 lb. steam per hour each
1925	Watertube boilers	Pulverized fuel but rearranged furnaces	50,000 lb. steam per hour each
1927	New boilers	Pulverized fuel	230,000 lb. steam per hour each

The experience gained on land in the matter of burning powdered coal is not directly applicable to marine purposes, as the furnaces of land boilers can be made higher and longer than ship boilers; and as the flame produced from powdered coal may be 20, 30, or 40 feet long, or even more, there is not the same difficulty in making boilers to suit such flames as there is for ships. Mr. Peabody has produced a burner (Fig. 2) designed to make a short enough flame to burn in an ordinary sea-going marine boiler having cylindrical furnaces, and has fitted these burners to two boilers in the S. S. *Mercer*, which has twice crossed the Atlantic. This type of burner can be readily adapted for burning oil, so that at any rate during the infantile stages of its development aid can be readily got from oil in case of need. Other burners have been proposed, but so far no experience is available of their use at sea.

An integral part of the plant necessary for the making of powdered coal is the mill which takes the coal after it has passed the crusher in its process of being reduced to about 1½ inches in size, and mills it into powder, from which it is blown through the burner accompanied by air of proper amount and pressure and burnt in the furnace. The kind of mill which was fitted on the S. S. *Mercer* is one in which hard steel balls of about 3 inches diameter are tumbled or whirled round in a cylinder, and thus powder the coal which is being fed into the mill. It is claimed that the result of the plant on the *Mercer* are sufficiently satisfactory to justify the experiment, and that a saving of 10 percent over hand firing may be expected from the use of such plant. The boiler efficiency determined in the Philadelphia Navy

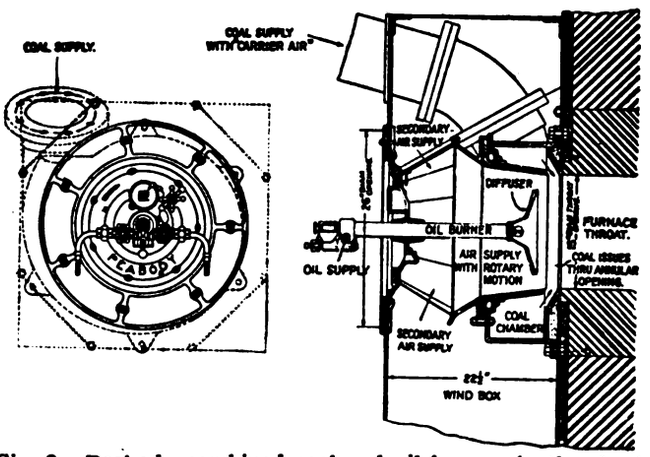

Fig. 2.—Peabody combined coal and oil burner (optional oil burner shown dotted in sectional view)

In marine boilers the front plate is carried on hinges (not shown) and swings out, carrying with it the air register and also the oil burner, if present, leaving an open throat.

Yard in a Scotch boiler using pulverized fuel in a Peabody burner was 70 to 77 percent, and 79.6 to 83.8 percent in a Babcock boiler of marine type at the Bayonne Plant.

It seems, therefore, that in order to give coal a chance to hold its own against oil, the methods which have to be adopted in oil fired boilers must be imitated. The coal must be pumped on board. Coal is already being handled pneumatically in this country at the rate of 50 tons per hour through a single pipe. A combina-

TABLE I.—TABLE SHOWING SAVINGS IN RUNNING COSTS OF VARIOUS TYPES OF MACHINERY OF 3,600 SHAFT HORSEPOWER ON CONTINUOUS SEA SERVICE IF THEY ARE USED INSTEAD OF THE ORDINARY TRIPLE EXPANSION ENGINE AND LOW PRESSURE CYLINDRICAL BOILER

	1 Ordinary Triple Steam	2 Ordinary Triple Superheated Steam	3 Quadruple Superheated Steam	4 Turbine with Superheated Steam. Cylindrical Boilers	5 Turbine with High Pressure Watertube Boilers. Superheated Steam	6 Turbine with High Pressure Watertube Boilers and Mechanical Stokers	7 Turbine with High Pressure Watertube Boilers and Pulverizers	8 Oil Engines
Boiler pressure, lb. per sq. in.....	200	200	200	200	525	525	525	—
Temperature, steam	390° F.	590° F.	590° F.	590° F.	750° F.	750° F.	750° F.	———
Cost of machinery	£36.000	£39,500	£46,000	£56.000	£62,000	£63,500	£68,000	£85,000
Consumption, tons per day.....	62	56	52½	44½	40½	38½	36½	17½
Pounds per S.H.P. per hour.....	1.6	1.45	1.36	1.15	1.05	1.00	0.95	0.42
Weight of machinery, tons.....	850	850	880	750	720	740	770	825
Difference in weight in tons carried due to difference in fuel carried for 200 days	Zero	1,200	1,900	3,500	4,300	4,700	5,100	8,900
Difference in weight in tons carried due to difference in weight of machinery for ten voyages per year.	Zero	——	300	1,000	1,300	1,100	800	250
Difference in cargo earnings at £1 per ton per voyage for ten voyages per year.....	Zero	£1,200	£1,600	£4,500	£5,600	£5,800	£5,800	£9,150
Savings in fuel costs in 200 days at £1 per day.....	Zero	£1,200	£1,900	£3,500	£4,300	£4,700	£5,100	—£1,600
Cargo, net earnings in excess of triple steam, Column 1.....	Zero	£2,400	£3,500	£8,000	£9,900	£10,500	£11,000	£7,550
Charges, 18½ percent of cost of machinery, in excess of triple steam, Column 1	Zero	£647	£1.850	£3,700	£4,810	£5,087	£5,920	£9.065
Net savings per year over triples..	Zero	£1,753	£1,650	£4,300	£5,090	£5,413	£5,080	—£1,515

Oil is taken at 80s. per ton.

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tion of such plants would coal any vessel. It must also be forced into the furnaces in a way similar to that in which oil is used. This was not done in the case of oil until a proper oil burner was developed, and was not worked successfully until time had shown what precautions are necessary to avoid undue risk and to ensure reliability. This development was largely done by the Admiralty for its own war purposes, but as no war purpose seems likely to emerge in the immediate future which may lead to the development of coal burning by the Admiralty, some other Government Department may possibly take this matter in hand. The Fuel Research Board may be mentioned in this connection.

To state the economic position at the present moment, taking account of actualities and possibilities, Table I has been prepared, based on costs supplied by firms willing to build at the prices named and fuel consumptions actual in some cases, and in others deemed to be possible. The boiler arrangements for the high pressure proposals are for 3,600 shaft horsepower turbines on continuous sea service, and are for three boilers abreast. It is quite practicable to produce the power with two boilers. The first cost of using two instead of three will be about £2,000 less in the case of the boilers with mechanical stokers and £2,500 in the case of the boilers fitted with pulverizers, and the final savings will be increased by £400 to £500 per year above the three boiler arrangement.

TABLE II

Type	Triple Steam	Oil Engine	Oil Engine	Oil Engine	Oil Engine
	£	£	£	£	£
(1) Cost of machinery...	32,000	61,200	75,000	84,500	87,000
(2) Cargo earnings in excess of triples due to difference in weights of fuel and machinery	——	7,040	6,240	6,390	5,440
(3) Charges in excess of triple	——	5,402	7,955	9,712	10,175
(4) Net savings per year (difference between (3) and (4))	——	1,638 more	1,715 less	3,322 less	4,735 less

Oil is taken at 80s. per ton.

The figures in Table I do not deal with costs of wages, food, fresh water, or machinery repairs. They only deal with the costs of machinery and fuel and the cost charges due to interest, depreciation, and insurance. They deal only with the differences in weight carrying due to machinery and fuel.

The subject of repairs is probably the one in which different types of machinery differ most. There is very little published information as to the upkeep costs of oil engines. The only case which has come under my notice is for two oil engined ships which averaged 40,000 miles per year and cost each about £10,000 per year for maintenance and £2,000 per year for lubricating oil. Other ships of the same size and power propelled by steam, which steamed 60,000 miles each year, had corresponding figures of £1,350 for maintenance and £300 for lubricating oil. These figures are actual, but may not be usual. Perhaps someone who is familiar with the costs of maintenance of ships' machinery may be disposed to enlighten us as to these costs.

Unfortunately for the exact determination of the relative commercial efficiency of different systems of power production, the first costs of machinery are not fixed nor easily determinable. For instance, one builder's price for a triple expansion set of ordinary machinery is about £32,000, and for an oil engine set of the same power £84,500. The corresponding figures from another builder are £40,000 and £75,000, and from a foreign builder as low a price as £61,260 for an oil engine. While the figures given in Table I are fair average figures upon which the number of ships of the types suggested are likely to be built, it is thought that it may be interesting to give the result of calculations based on the other figures mentioned. Table II shows these results.

Confining our attention to the differences in savings between high pressure turbines and the oil engine, we have the following:

TABLE III.—ANNUAL SAVINGS OF H.P.T. STEAM OVER OIL

	H.P. Turbines — Coal-fired W. T. Boilers	H.P. Turbines — Mechanical Stokers	H.P. Turbines — Pulverizers
	£	£	£
Savings of H.P.T. over triple.....	5,090	5,413	5,080
Excess over triple in oil engine.....	—1,515	—1,515	—1,515
Annual savings of H.P.T. over oil engine....	6,605	6,928	6,595
Difference in other expenses.....	350	350	350
Gain of steam H.P.T. over oil engine per year.	6,255	6,578	6,245

If we take the triples at £32,000, as per table II, instead of £36,000 as in Table I, the savings of H.P.T. over triples will be:

£4,350 £4,703 £4,340

and the savings of the oil engines in Table II over the triples being:

+£1,638 —£1,715 —£3,322 —£4,735

the difference between the H.P.T. and the oil engines will range from

£2,702 to £9,438

per annum in favor of the steam according as the price of the oil engine ranges from £61,200 to £87,000.

It is suggested that the foregoing give some of the figures relevant to the present position of the fuel question, and it is hoped that they will afford scope for discussion wherever shipowners and naval architects have the desire to produce the most economical ships.

Dredge Fuel Bill Cut $108 a Day

STEAM dredge equipment is notoriously inefficient and yet these old dredges are operated year after year at high operating costs when Diesel equipment would pay for itself in a remarkably short time. In many cases the capital investment required to make the change over is the main obstacle standing in the way of modernizing such equipment.

That the savings are ample to pay for the Diesel equipment in a very short period is shown by the experience of the Central Sand and Gravel Company of Memphis, Tennessee. This organization installed a 180 horsepower Fairbanks-Morse Diesel in a sand and gravel dredge called the *Milly Fry*. The engine is direct connected to a 15-inch Ellis gravel pump through a Cutler Hammer magnetic clutch and also drives a 45-kilowatt 230-volt direct current generator which furnishes current for the auxiliaries. These auxiliaries consist of a suction hoist powered with a 20 horsepower 230-volt, 1150 revolutions per minute motor; an anchor hoist powered with a 30 horsepower 1150 revolutions per minute motor; a 3-inch centrifugal pump for bilge service; a 7½ horsepower motor, lighting equipment, electric ranges and coffee percolators in the galley.

Records obtained from Chief Engineer John Peterson, of the Central Sand & Gravel Company, show that for March 1928 the fuel and lubricating oil bill on the dredge was $1.32 per hour as compared with a fuel cost with steam equipment of $5.85 per hour. The saving on this item alone is, therefore, $4.50 an hour or a total of $108 for each 24-hour run. This record is for gravel only. In pumping gravel it is necessary to pump practically three times as much sand as gravel as the sand is washed out and the gravel is retained. During the month of March, 39,010.57 tons were handled and

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659 cars of gravel were loaded. The fuel consumption during this time was 5,212 gallons of 36-38 distillate costing slightly less than 6 cents per gallon. During this time 200 gallons of lubricating oil were used which included lubrication for all of the auxiliaries and the pump, from which the oil could not be reclaimed. This figures 0.134 gallon of fuel oil per ton or approximately 7½ tons of clean washed gravel per gallon of fuel.

Crew Reduced from 17 to 10 Men

In addition to this very substantial reduction in fuel costs there has also been a considerable saving in labor cost. The present equipment is operated by a double crew of five men, the total crew for 24 hours operation consisting of ten men. When the dredge was operated with steam equipment the double crew consisted of seventeen men including the fireman. The Diesel equipped dredge thus saves the labor of seven men.

This equipment has been in operation for a period of eight months. During this time there has been no expense for repairs and the operation has been 24 hours per day, 6 days a week.

The same interests that control the Central Sand & Gravel Company at Memphis also own the Greenville Stone & Gravel Company of Greenville, Mississippi, and operate a duplicate dredge at that point. This dredge is also equipped with a 180 horsepower Fairbanks-Morse Diesel with corresponding auxiliary equipment.

Motor Cargo Ship Highland Monarch Launched

THE twin-screw passenger and refrigerated cargo motorship *Highland Monarch*, which is the first of five similar vessels ordered from Harland & Wolff, Ltd., by H. & W. Nelson, Ltd., was successfully launched on May 9 from the builders' East Yard, Belfast, Ireland. The new vessel and the four others which are under construction are intended for the owners' passenger, general cargo and refrigerated produce trade between the United Kingdom, Brazil and the Argentine via Spain and Portugal, and will mark a notable advance in this increasingly important service.

The vessel has been constructed to meet the Board of Trade and Lloyd's 100 A1 class requirements, and also to comply with the Spanish and Argentine laws relating to the carriage of emigrants. Her principal dimensions are:

Length between perpendiculars	520 feet	
Beam	69 feet	
Depth (to upper deck)	35 feet	9 inches
Gross tonnage	14,450	

Accommodation will be provided for 135 first-class and 66 intermediate-class passengers, as well as for a large number of emigrants.

The vessel is fitted with nine watertight bulkheads. The double bottom, which extends the whole length of the ship, is arranged for the carriage of water ballast, fresh water and oil fuel. A very handsome appearance is given to the vessel by a cruiser stern and two of the low type funnels which are becoming the distinguishing feature of the large motor liner.

A distinctly old-English note has been struck in decorating and fitting up the first-class public rooms, oak panelling of different shades being used throughout, with oak beamed and ivory white ceilings, after the manner of the old English houses in the days of the Tudors. The furniture is in the same style, but notwithstanding the old-world atmosphere imparted to these rooms, full advantage has been taken of the most modern methods of lighting to avoid the brilliant glare of electric lighting, and, except in the case of the smoking room, indirect lighting reflected from concealed lamps in the frieze is used. The first-class public rooms include a lounge and recreation room, writing room and library, dining room, smoking room and veranda.

The first-class staterooms are on the bridge and shelter decks and are mainly 2-berth cabins, the walls being finished a smoke green shade and the furniture in oak.

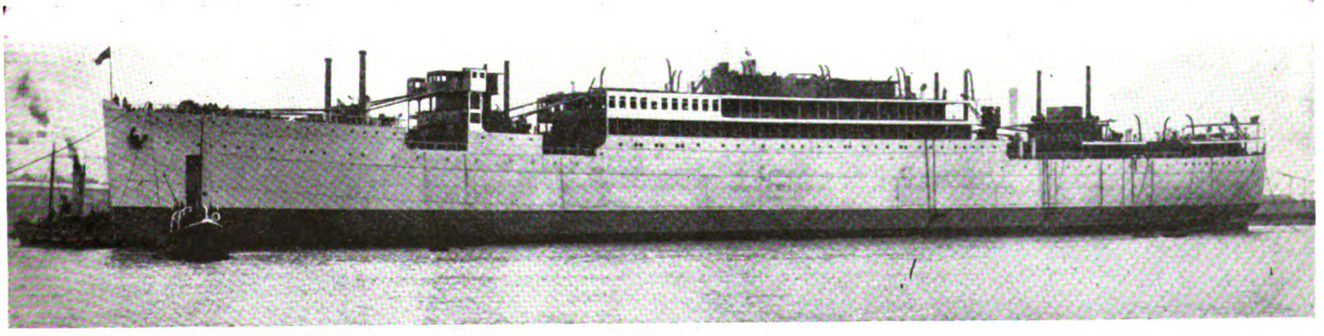
The intermediate accommodation is arranged aft in 2-berth and 4-berth staterooms, which are fitted out in a very high class manner. The public rooms for the intermediate class passengers include a dining saloon, smoking room and ladies' room.

Auxiliary Machinery

The cargo carrying facilities are of the most up-to-date character. Five of the holds and most of the 'tween decks are insulated and arranged for the carriage of chilled meat. The main refrigerating machinery consists of two duplex machines with double-acting anhydrous ammonia compressors, each machine being direct-driven by a horizontal vis-a-vis type 4-cylinder Diesel engine. A separate electrically driven machine is fitted to deal with the provision chambers.

The vessel has an important electrical installation, consisting of four Diesel-driven generators, each having an output of 200 kilowatts at 220 volts. These dynamos run in parallel and supply current to a large switchboard, from which it is distributed throughout the vessel.

The lighting of the ship will be adequately provided for in all departments. Electric motors are installed to drive all ventilating fans and all the engine room and deck machinery, including the steering gear, capstans, windlass and winches. The vessel is electrically heated throughout, and, in addition to the electric radiators, each state room is also provided with its own ceiling fan



The M. S. Highland Monarch just after launching

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and berthlight, all being under the control of the passenger. The watertight doors are electrically operated and controlled from the bridge.

An interesting feature is the installation of lights on the boat deck, which, while normally used for giving illumination for dances, can, if required, be instantly swung outboard to give the necessary light for operating the boats. The vessel is also equipped with a very complete modern telephone and bell installation, and wireless apparatus of the latest type.

Propelling Machinery

The propelling machinery, which has also been constructed by the shipbuilding firm, consists of two 8-cylinder, double-acting, 4-cycle Diesel engines of the Burmeister & Wain type. Each engine drives its own three-stage injection air compressors through cranks mounted at the forward end of the main crank shaft. The cylinders are cooled by fresh water and the pistons by oil.

The four main generators are driven by six-cylinder Burmeister & Wain trunk-type Diesel engines, fitted with specially large compressors which supply the necessary maneuvering air, the latter being stored in four large cylindrical type tanks. One small steam-driven emergency compressor is also fitted. Two emergency motor sets are provided in a separate room which is located above the load waterline forward of the main motor room.

A notable feature of the machinery installation is the boiler for supplying the steam for heating, cooking, etc., which can be fired either by a separate oil-burning arrangement or by the exhaust gas from one or both of the main engines.

Turbo-Electric vs. Diesel Drive in Passenger Ships*

By Dr. W. L. R. Emmet†

IN *The Motor Ship* for March, a discussion of turbo-electric *versus* Diesel drive appears, which is based upon reports of a talk which I recently gave to the Propeller Club in New York. This article compares a reported fuel oil consumption of 0.8 pound per shaft horsepower hour of the new *California,* with 0.4 pound in a Diesel ship, and states:

"In other words, the amount of oil used on the most modern and efficient turbo-electric liner is approximately double that required for a motorship of the same size and power."

Since similar numerical comparisons have often been made, and are grossly misleading, it seems desirable that an approximately true relative evaluation should be drawn, and the best basis for this which I have been able to find is a comparison between the *California* and the *Gripsholm,* of the Swedish-American Line.

The *Gripsholm* has a displacement of 23,600 tons, and is operated at about 16 knots, while the *California* has 30,250 tons displacement and her normal full speed is 18 knots. I will compare the performances of the two ships when operating at 16 knots, which is unfavorable to the *California* since she must use two generating units lightly loaded at a speed above about 15.5 knots.

At 16 knots, the fuel consumption per day of the *Gripsholm* is 61 tons of fuel oil and 1 ton of lubricating oil, which, since lubricating oil costs eight times as much as fuel oil, may be considered as the equivalent of 69 tons of fuel. The *California* uses 106 tons of fuel and no appreciable quantity of lubricating oil.

These consumptions are for all purposes and, since the *California* cooks by electricity and refrigerates a large cargo of fruit through two-thirds of her round trip, the all-purpose comparison is in no way favorable to her.

Thus the fuel consumptions in pounds per ton-mile are:

California	0.0211 pound
Gripsholm	0.01715 pound

An operator of many Diesel ships and steamers in a very recent large contract paid at New York for Diesel oil $15 per ton, and for oil burned in their steamers $10.20 per ton. The prices per 1,000 ton-mile are, therefore: *California,* $0.096; *Gripsholm,* $0.1145. The *Gripsholm* is, however, entitled to a credit here since the larger ship drives more easily per ton. This correction brings the comparison to *California* $0.096; *Gripsholm,* $0.106 oil cost per 1,000 ton-miles (displacement tons).

The difference in cost of machinery between the *Gripsholm* and a similar ship with turbo-electric drive is not known, but, on the basis of comparison of Diesel and geared turbine ships given by Sir John H. Biles in *Engineering,* June, 1926, it would be about $250,000 in favor of the turbo-electric ship. The value of this saving, if considered on a percent basis, is equivalent to about 10 percent of the annual fuel bill. There would also be an appreciable saving of weight.

The second liner, which is being built for the I. M. M. Company, has 75 pounds higher steam pressure and 150 degrees more superheat than the *California,* and, with equally good turbines, her propulsion should be 10 percent more efficient.

Thus, instead of being half as good as *The Motor Ship* suggests, the above comparisons show that on this fuel price basis a good turbo-electric ship of the type planned for the third I. M. M. vessel might have advantages equivalent to a fuel saving of about 28 percent And, even if both burned the same kind of fuel, they would be not much more than equalized.

But the *California* has many other advantages. Her machinery involves no motion other than simple rotation. She is completely free from noise or vibration at all speeds. She can make 15.5 knots with half her machinery idle. There is practically nothing which could happen to her machinery which, with a few spare parts, could not be repaired at sea.

The part of this argument which will be most subject to question is the matter of Diesel oil price. I know that some of the advocates of Diesel engines say that they can burn anything, and these relative prices may be very different in other parts of the world. My figures are based upon actual prices in very large quantities, and I am informed that since these purchases another large firm has paid $16.20 per ton for Diesel oil instead of the $15 which I have considered. There will always be a difference between desirable Diesel oil and oil for steam making, and my claim is that, even without an advantage in oil price, the well-designed turbo-electric ship of this type is justified.

There is one condition which may greatly influence the uses of electric drive, namely, that its adoption takes the building of machinery away from shipbuilders. Shipbuilders have frequently discriminated against it in making ship prices and this has been the main cause of its delay. It is hoped that the performances of the *California* and other large ships now building will do much to overcome this impediment.

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* From *Shipbuilding and Shipping Record,* May 31, 1928.

† Consulting engineer, General Electric Company, Schenectady, N. Y.

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Scantic Line Develops Bonus System

Payments to officers and men reduce operating costs and turn-over of personnel

THE American Scantic Line, Inc., operated by Moore & McCormack Company, Inc., New York, has developed a bonus system that has proved successful in reducing the costs of ship operation and turn-over of operating personnel. This system was developed by the operating department under the direction of Robert C. Lee, vice president, and through this system the Moore & McCormack Company is able to pay, on account of savings made, voluntary contributions to officers and men permanently attached to each vessel.

Bonuses are divided into three main classes: Longevity, fuel saving and annual.

Bonus for Longevity

One of the difficult problems confronting every employer is the question of turn-over. Advantages accrue to a ship and to a service, if the personnel in that service remains as near permanent as possible. In order to encourage this permanency, so that officers and men may look upon their ship as their own particular domain and take pride in its preservation and success, and to provide that officers become thoroughly familiar with the best routes, safe conduct of the vessel, and the nature and best care of cargo, and that they become personally acquainted with shippers and receivers, agents, stevedores, suppliers, pilots, etc., the American Scantic Line has established a seniority list and plans to pay longevity bonuses as follows:

Each officer and man to be paid in addition to his regular wages:

From the end of the first year to the end of the second year, $5 per month additional.
From the end of the second year to the end of the third year, $7.50 per month additional.
From the end of the third year to the end of the fourth year, $8.75 per month additional.
From the end of the fourth year to the end of the fifth year, $9.50 per month additional.
From the end of the fifth year to the end of the sixth year, $10 per month additional.
From the sixth year continuously thereafter, $10 per month additional.

Bonuses are governed by the following rules:

The computation for longevity begins from January 1, 1928, or from the date of joining thereafter.

Rules Governing Awards

The computation will not be made strictly for the calendar year, but will begin with the first voyage after the calendar year has expired. This rule is necessary in order that the articles show the bonuses that are to be paid and that new articles will not be necessary on a voyage where changes in a man's status has occurred.

Beginning the first voyage after January 1, 1929, articles may bear notations as follows:

"Persons named shall receive in addition to the regular pay for which they are signed on, a bonus of amount indicated on account of continuous service. This amount shall be paid in total at the end of the voyage, and is only due in case the person makes the full round voyage."

Longevity may be paid for continuous service only, and continuous service will be construed to mean continuous service on the same ship during all of the time that the crew is signed on, unless transferred by the order of the company to another ship or unless on authorized leave of absence. The loss of ten numbers in seniority will carry with it a loss of credit of one year longevity service.

Bonus for Fuel Saving

In order to encourage a reduction in fuel costs, which comprise about 20 percent of the cost of a voyage, the American Scantic Line will pay a bonus for fuel saved under the following rules. The company establishes a basic fuel consumption per mile steamed based upon past performance. It also establishes a basic fuel consumption per day in port. These basic figures are changed from time to time as conditions warrant. At the end of each voyage a computation is made and the actual value of the fuel saved over the basic consumption established is distributed to the company and officers as follows:

Chief engineer, 10 percent of the saving
Master, 5 percent of the saving

Each of the following, if over one year in the employ of the American Scantic Line:

First assistant engineer, 3 percent of the saving
Second assistant engineer, 2 percent of the saving
Third assistant engineer, 1 percent of the saving
Engineer crew, 4 percent of the saving

These bonuses are not paid to officers or men who fail to sign on for the succeeding voyage unless properly excused, in which case they are paid as soon as possible after signing on, and of course after computations have been made. They are paid in cash in a lump sum for each individual. Shares forfeited through failure to sign on are returned to the company.

Annual Bonuses

The following bonuses will be paid annually, as soon as computations can be completed after the termination of the voyage nearest to December 25 of each year, beginning December 25, 1928. As these bonuses might very possibly be earned even though the ship is not maintained in A-1 condition and as a further incentive to maintain the vessels in good condition, no such bonuses will be paid to any ship which, at the inspection made on completion of each voyage, receives an unfavorable report as to upkeep, cleanliness, or condition of machinery, cargo, gear and hull. As a further incentive to continuous service, payments will be made only to those officers and men who have served throughout the year, and who are still in the service. Payments that might be awarded to others will revert to the company.

Bonus for Repairs

The company will establish a basic cost for repairs. Of any saving over this basic cost shown by a vesse the company will pay to all officers and men who have been on board the vessel throughout that year the following amounts:

Master, 5 percent of the saving
Chief engineer, 4 percent of the saving
Chief officer, 2 percent of the saving
Second officer, 1 percent of the saving
Third officer, 1 percent of the saving
First assistant engineer, 3 percent of the saving

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Second assistant engineer, 2 percent of the saving
Third assistant engineer, 1 percent of the saving
Wirless operator, 1 percent of the saving
Steward, 1 percent of the saving
Crew, 4 percent of the saving

Bonus for Stores

The same rules as for repairs will apply on stores, with the following distribution:

Chief engineer, 5 percent of the saving
Chief officer, 3 percent of the saving
Second officer, 1 percent of the saving
Third officer, 1 percent of the saving
First assistant engineer, 3 percent of the saving
Second assistant engineer, 1 percent of the saving
Third assistant engineer, 1 percent of the saving
Steward, 5 percent of the saving
Wireless operator, 1 percent of the saving
Crew, 4 percent of the saving

Bonus for Vessel's Profit Over a Year

If the vessel's accounts for the year show a profit of revenue over operating costs, including depreciation and interest on the investment, the following distribution will be made:

Master, 4 percent of the net profit
Chief engineer, 1 percent of the net profit

and one percent for each of the other officers who have been on board throughout the year.

Claim Bonuses

Regulations require that the master shall be responsible for the safe carriage of cargo. In addition it is required that an officer or petty officer be detailed in charge of each hold. As far as possible the person charged with the hold shall be definitely assigned to that hold in accordance with the instruction book of the American Scantic Line, and at all times held responsible for it. Upon payment of annual bonuses there will be paid to such persons who have served in charge of a hold throughout the year on the vessel having the best claim record in the fleet for the year, the following cash bonuses: $250 for the master, $100 to the chief officer, and $100 to those who have served in charge of a hold throughout the year.

General Instructions

None of the bonuses listed under annual bonuses will be paid to any vessel that suffers any marine disaster during the year except by special ruling under extraordinary circumstances. These special rulings will be made so as to enable the engine department of vessels suffering marine disasters to receive their earned bonuses provided the disaster is in no way attributable to machinery failing, and on the other hand to provide for the payment to the deck force in case the disaster is attributable to machinery failing.

General Reservations

The bonuses provided are voluntary contributions to be made by the company to its employees for the purpose of promoting the best interests of the company, and are not binding upon the company until such time that the bonuses have become due and payable and funds have been appropriated for the payment of the bonuses. The interpretations of the foregoing plan shall rest solely with the president of the company whose decision shall be binding on all the parties concerned.

Six ships are now operating under this system, including the steamships *Argosy, Bird City, Caspar, Minnequa, Sagaparack* and *Schenectady.*

Although the bonus plan has only been in operation since January, 1928, definite improvements and savings have been noticed by the executives of the American Scantic Line. The saving in fuel alone has been of considerable importance and mutual benefit is foreseen by all the employees as well as the officials of the line as a result of this plan.

Largest Dry Dock in New York Under Construction

GRAVING Dry Dock No. 1 at the Robins Dry Dock and Repair Company plant at Erie Basin, Brooklyn, N. Y., a subsidiary of the Todd Shipyards Corporation, New York, was built in 1866, entirely of wood and of dimensions to suit vessels of that period, 500 feet long, 26 feet from ground to floor of dry dock, 48 feet wide at the bottom and 115 feet wide at the top. In the 62 years interval, types of vessels have so materially changed that the dock is now unsuited to modern vessels. It was, therefore, decided to entirely rebuild this dock along modern lines to suit modern vessels.

The engineering services of Rear Admiral Frederic R. Harris, U.S.N., (Retired), were obtained and a modern graving dry dock of steel and concrete construction designed.

This new dry dock is under construction on the site of the present dry dock and will be 715 feet long in the clear, the depth from ground to floor of dock to be 40 feet, 93 feet wide at the bottom and 113 feet wide at the top.

An entire new pumping plant will be installed, which will un-water the dock in about three-quarters of an hour. The main pumping plant will consist of two 600 horsepower motor-driven pumps. Two smaller pumps will be provided for drainage purposes. The pumping plant will be entirely underground, and hydraulically operated sluice gates provide for watering and unwatering the dock.

The work of construction is being carried out entirely by Robins' own employes. The approximate amounts of materials involved are 50,000 cubic yards of concrete, 2,500 tons of steel sheet piling, 3,500 tons of structural and reinforcing steel, 4,000 40-foot wood piles and 750,000 board feet of timber. All special and regular equipment necessary for the construction work has been procured.

The construction is divided into two sections, inshore and outshore sections. The inshore section will be built by driving two lines of steel sheet piling around the dock, excavating the material between, driving piles and building up the walls of the new dock. After this has been accomplished the remaining center portion will be excavated, piles driven and the floor of the new dock finished off. The outshore section will be constructed by laying concrete under water, known as the Tremie method. The first operation is to dredge to the required depth, pile under water, then lay steel structural forms thereon to receive the Tremie concrete. In the meantime a new steel caisson gate will have been constructed and at this stage of the operation will be placed in its outer seat. The dock will then be pumped out and finished off in the dry.

A special feature of the construction of this dock will be the method of constructing the pump well, which will be 60 feet deep and will be done by the open caisson dredging method.

It is estimated that the length of time required to complete the work will be a year and a half, at a cost of $2,000,000.

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A New Problem in Steel Corrosion

Corrosive effect of white lead paint where used to mark sheets for forming at elevated temperatures

ONE of the most recent phases of the iron and steel corrosion problem, requiring immediate investigation, developed not long ago in the boiler department of one of the greatest locomotive works in the country. This company had for some time been using Toncan copper molybdenum iron boiler plate for the flue sheets of the McClellon type boiler with marked success. In one particular instance, a ruptured surface

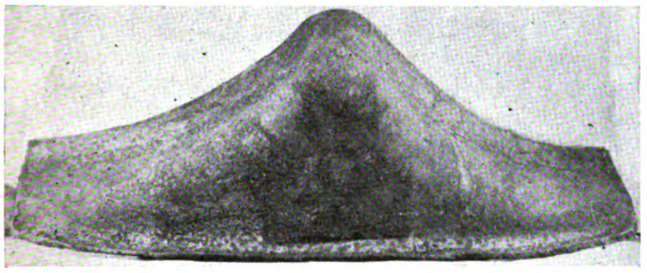


Fig. 1.—Section of flue ring, showing ruptured areas on the surface

condition was discovered on the finished section of one of the sheets. This rupture had apparently occurred where the heat number or other identification numbers had been painted on the surface prior to heating the plate for flanging. Figs. 1 and 2, indicate the ruptured surface condition that was produced.

Micro-Examination of Ruptured Plate

An investigation was immediately started to determine whether or not the white lead paint was entirely responsible for the bad surface condition obtained. Micro sections were cut from various parts of the defective plate, adjacent samples of a good surface and of a bad surface being obtained at three places. The location of these samples is shown in Fig. 3. This examination revealed the ruptures to be cracks of irregular outline and of depths varying from 0.007 to 0.020 inch. At the base of the large cracks numerous smaller cracks were seen which suggested that the cracks were intercrystalline. No foreign substances, such as non-metallic inclusions, were found within the cracks. When examined in the etched condition, the grain size around the cracks was found to be smaller and uniform from the surface to the center of the plate. The following photo-micrographs, Fig. 4 and Fig. 5 (at 100 magnifications), show typical etched and unetched views of a good and of a bad surface from adjacent positions on the defective flue ring.

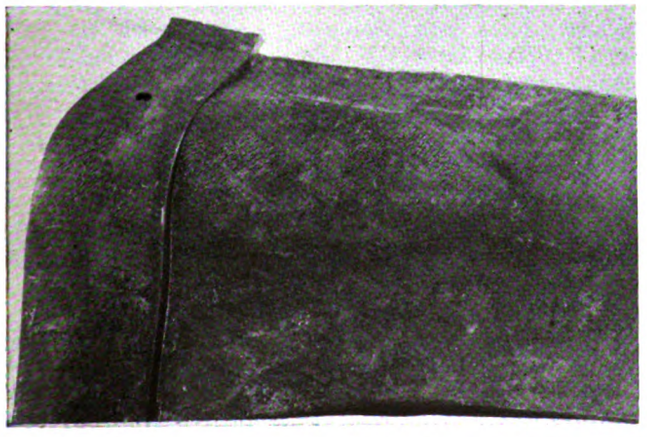


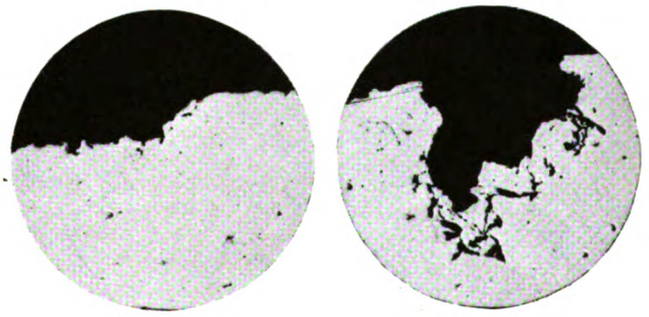
Fig. 2.—View showing details of ruptured area

Fig. 3.—Coupons cut from ruptured surface for examination

Effect of White Lead on Sheet Material

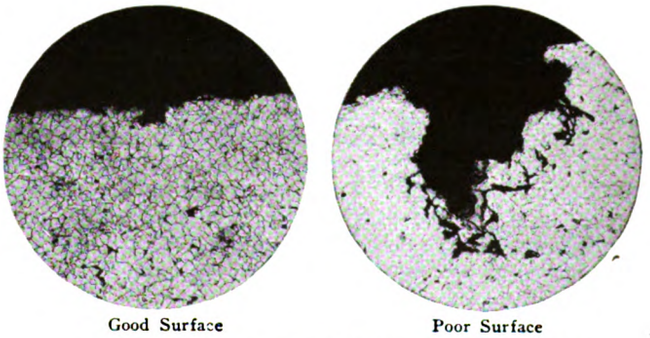
Before making the definite conclusion that the ruptured surface was due to a corroding action of the white lead at forming temperatures, it was thought advisable to make a study of the corrosive properties of white lead on the surfaces of several types of sheet iron and steel when heated above a red heat.

To carry out this experiment, 5-inch by 8-inch sections of 26 gage (0.018 inch thick) Toncan copper molybdenum iron, Toncan enameling iron, copper bear-



Good Surface Poor Surface

Fig. 4.—Unetched test samples



Good Surface Poor Surface

Fig. 5.—Test samples etched with nital solution

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ing steel, commercial pure iron, high phosphorous sheet steel and low carbon sheet steel were used. The defective flue ring from the locomotive boiler had practically the same analysis as that of the Toncan copper molybdenum iron used in the experiment, except that it had a higher manganese content of 0.39.

These sections were painted in the center with white lead, a somewhat heavier coat of paint being used than would ordinarily be the case. After the paint had dried, the sections were placed in an electric furnace and heated to 1,550 degrees Fahrenheit (a temperature often exceeded in forming and flanging operations) for one hour. Following the heating, these samples were cooled by air.

Figs. 6 and 7 aptly show the disastrous corrosive action of the white lead in actually producing holes in the sheets. While all six types of sheet used in the experiment were corroded clear through, the Toncan copper molybdenum iron was not attacked as badly as the other types.

Chemical Reactions

White lead paint is composed of a basic lead carbonate [$2PbCO_3$. Pb $(OH)_2$] in a linseed oil base. The reactions taking place are (1) a decomposition of the basic lead carbonate by heat alone and (2) a reduction of the resulting lead oxide by iron of the sheets and by carbon from unignited linseed oil.

The decomposition of white lead takes place at about 400 degrees Fahrenheit, leaving the yellow lead oxide, litharge, PbO. Some of this yellow oxide could be observed on the test plates as the heating progressed.

$$2PbCO_3 . Pb(OH)_2 + \text{heat} = 3PbO + 2CO_2 + H_2O$$

The reduction of litharge takes place at a red heat (about 1,000 degrees Fahrenheit) by action of iron

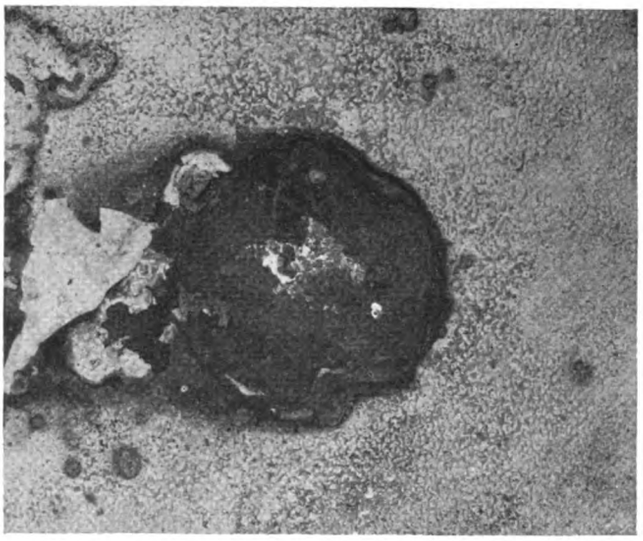

Fig. 6.—Toncan copper molybdenum sheet

from the sheets and by carbon from the linseed oil, after the ignition of its volatile constituents. Metallic lead is formed by the reducing action of iron and carbon. A large button of metallic lead was found on the sheet or on the floor of the furnaces (where the molten lead ran through the sheets) after cooling.

Some of the white lead paint when heated to 1 550 degrees Fahrenheit in a porcelain crucible with no iron present gave a residue of metallic lead. This demonstrated the action of carbon from the decomposed linseed oil in reducing lead oxide. In all cases a black

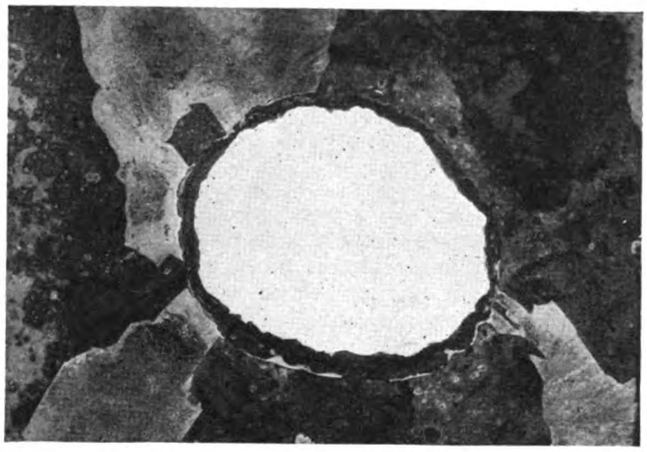

Fig. 7.—High phosphorus sheet steel

mass was formed on the sheets showing the presence of carbonaceous matter from linseed oil.

It should be mentioned that the soda iron or iron nail method of assaying sulphide ores takes advantage of the fact that iron reduces lead from litharge, as well as from the common lead minerals. This method consists of a reducing fusion of the ore with a large amount of sodium carbonate as well as a limited amount of litharge and borax, together with an excess of metallic iron in the form of nails or spikes.

The equations for the reduction of litharge by iron and by carbon at red heat are given below:

$$PbO + Fe = FeO + Pb$$
$$2PbO + C = CO_2 + 2Pb$$

The iron oxide formed may at this temperature change to common scale, Fe_3O_4.

$$6FeO + O_2 = 2Fe_3O_4.$$

The scale of course flakes off until finally a hole is left in the sheet.

Again it is known that iron oxide (Fe_2O_3) is soluble in litharge to the extent of one part iron oxide in ten parts of litharge. This also aids in the oxidation of the iron.

Conclusions

The investigations performed on the iron sheets show conclusively that white lead paint has an intense corrosive action on iron and steel when heated to temperatures used in forming or flanging operations.

This corrosive action may actually produce holes in sheets of light gage.

The effect of the corrosive action of white lead paint on heavy plate is to produce an over-oxidized or "red-short" surface layer when heated for forming, which results in ruptured or defective plate surfaces.

Obviously the use of white lead paint for marking iron or steel surfaces should be avoided.

LARGEST ELECTRIC LINER.—The *Virginia* of the Panama-Pacific Line will supplant the *California* of the same line as the largest electric driven ship ever built when she is launched in August at the yards of the Newport News Shipbuilding and Dry Dock Company. According to engineers of the General Electric Company, who are supplying the machinery, the *Virginia* will be a duplicate of the *California* in most details, but will measure 613 feet over all, as compared with 601 feet for the *California*. She will accommodate 801 passengers as against 751 carried by her rival.

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Diesel-Electric Drive for River Boats*

Experience with towboats and ferryboats indicates wide field for development in inland waterways' service

By R. A. Beekman†

THE principal claims advanced for Diesel-electric drive for boats in service on the Mississippi and other rivers are the high efficiency of this machinery and the elimination of the problem of silt and acid in the water as it occurs when steam equipment is utilized.

Push or Towboats

In view of the type of cargo and the methods of material handling which are found on the Mississippi river and its tributaries, the push or towboat seems to offer by far the greatest field for development. The applications to date have been made by the United States Army Engineers and consist of two 100-foot, three 70-foot push boats in operation and one 110-foot boat, the *Tecumseh,* recently placed in service in the St. Louis District.

These vessels are all of the stern wheel type, for it seems to be the opinion of the majority of river men that the stern paddle wheel is best suited to the conditions. The power demanded by the paddle wheel is dependent upon the number and load of the barges being handled, the depth of the channel, the velocity of the current, etc. With the Diesel engine directly connected to the wheel through mechanical means, the full load can be developed and absorbed at only one speed of the engine. If the conditions demand a reduction in speed, this is accompanied by a corresponding reduction in the power available and hence a slowing down of schedule. If, on the other hand, the conditions call for an increase in speed, this can be met only at a sacrifice of life of the engine. With the electric drive the engine speed may be maintained constant over the entire range of vessel speed, because the necessary change in ratio between the paddle wheel and engine speeds may be obtained electrically. In the earlier installations this was accomplished by changing the motor fields, but in the latest 110 foot boat, the *Tecumseh,* this is accomplished in a novel manner. which is described on page 336 of the June issue of MARINE ENGINEERING AND SHIPPING AGE.

Too much emphasis can not be placed upon the maneuvering ability of this type of drive. In narrow and congested channels, in coming alongside of docks and in handling the tows, this is an important factor. The pilot house control allows the pilot or captain to have directly at hand the means for controlling the speed and direction of the wheel, so that the response to his needs is immediate, and any possibility of confusion in transmitting signals to the engine room is eliminated.

Electrical Equipment Connected in Series

To date the applications have made use of a series connection of the generators and propelling motors. This grew out of the character of load imposed by the screw type propeller in sea-going vessels, and it also has advantages in the case of the paddle wheel. The whole question revolves about the governing means on the engine and hence the distribution of the load, hunting, etc. If the future development of paddle wheel boats indicates the desirability of parallel operation, the belief is that this is feasible due to the difference of the torque characteristics of this type of wheel, as compared with the screw type and, also, the difference in service.

While, to date, the installations which have been made on rivers have not called for operation of the vessel at reduced power over an appreciable length of time, yet it is quite likely that in the future, in studying definite schedules, the need for slowing down and speeding up between certain points will develop in this class of service. In this case the electric drive again has advantages, inasmuch as it allows of the multiplicity of units, a part of which may be shut down under reduced power demand and the remaining units operated at full load and hence with high economy.

River men seem to be quite unanimous in their feeling that a stern wheel boat handles considerably better when it is "down by the head"; i.e., with the bow drawing somewhat more water than the stern. If this be accomplished by making the stern with greater displacement, some loss in propulsion efficiency is encountered. It is, therefore, apparent that flexibility in the distribtuion of machinery is of some importance. With the Diesel-electric drive the only part of the equipment which need be located aft is the motors. The engine generating sets may be located forward in any convenient location and position, while this can be done with direct drive only with long shafts and complicated mechanical connections.

Ferryboat Service

The greatest number of Diesel-electric installations have been made in this field, but the ferries, with two exceptions, are in service in the harbors of large maritime cities, such as New York and San Francisco. However, there is no reason why river ferryboat service is not open to the same application and for the same reasons.

Of the two installations on rivers, one is at Louisville, Kentucky, and the other is on the Hudson at Poughkeepsie, New York. The former is of the side wheel type, while the latter is driven by screw propellers.

Many of the advantages of this drive applied to towboats pertain also to ferryboats. The maneuvering and reliability features are even more important in the latter case, due to the fact that the boats carry passengers. With the side wheel type, all of the prime mover units are available for driving either or both wheels, while with the direct-connected type the use of one wheel is lost in the event of failure of one of the engines. There are some instances where both side wheels are operated as one, but reliability and maneuvering ability are then sacrificed.

In the case of the ferryboat *F. M. Coots* at Louisville the size of the installation is such that the constant voltage system was chosen instead of the variable voltage. The motors are controlled in speed and direction in the usual manner by use of armature resistance.

Due to the greater height of the slow speed direct-connected engine as against the higher speed type used

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* Abstract of paper presented before the Engineers Club in St. Louis, Mo.

† Federal and marine department, General Electric Company, Schenectady, N. Y.

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for driving generators, the electric drive some times has the advantage of allowing a better use of the deck space for carrying passengers, automobiles and cargo.

While practically all of the western river ferries are of the side or stern wheel type, there seems to be no reason why in some cases the screw propeller, double ended type should not be used to advantage. It has been found that the most economical method of operation is to furnish all the propelling power to the stern propeller, while the bow motor is idled at such a speed, approximately 70 percent of that of the stern, as to just equalize its own losses. In the case of direct drive, this arrangement is not feasible, unless separate engines are provided for each propeller, which is entirely out of the question from the point of view of first cost, space and weight. Therefore, the two propellers either have to be driven at the same speed or clutches have to be provided for disconnecting the bow propeller, in which case this propeller is driven as a water wheel. The latter practice is not considered economical.

Electric Drive Fire Boats

In the case of electric drive fire boats advantages arise from the use of the same power plant for both propulsion and pump service. In addition, some of the operators insist that it is necessary to have a small amount of power available for turning the screw over slowly in order to hold the boat against the reaction of the fire nozzles, especially under certain conditions of current, etc. Electrical transmission will, of course, meet this condition with the same flexibility as it does similar requirements in the case of independent operation of multiple screw boats.

An added item of economy in the case of fire boats enters the consideration, for stand-by losses that would be encountered in maintaining steam through long periods of idleness are eliminated. With the Diesel engine this stand-by loss is reduced to a minimum and with the electric drive, making use of multiplicity of units, overhaul can be carried on without completely losing the use of the boat.

Stern Wheel Drive

There is one feature of electric drive as applied to stern wheel boats, which has caused much thought on the part of everyone who has studied this problem. This concerns the mechanical connection of the motors to the wheel. In small sizes this has been successfully accomplished by means of shafts and gears or chains, but all of these offer grave difficulties when applied to boats demanding 1,000 to 2,000 horse power and above. When one realizes the large torques involved in consuming this horsepower at between 15 and 30 revolutions per minute, it is not surprising that this feature has been cause for concern.

After careful analysis, several groups studying the problem independently have arrived at the conclusion that the use of connecting rods or Pitmans offers the most satisfactory solution. This type of connection has been successfully used for many years with the old grasshopper type of engine and certainly has demonstrated its merit.

However, difficulty arises with the Pitman type of connection, when we attempt to apply electric motors. In the case of the grasshopper reciprocating engine, steam is cut off before the end of the stroke and the idle Pitman is carried over the dead center by the working one. With the electric motor, however, unless we resort to extreme complications, the torque is applied continuously and there is grave danger that during maneuvering the driving cranks on either side of the vessel will be brought into opposition to each other. This is due to the clearances which naturally develop in the bearings, which will permit of a driving crank, when near dead center, dropping by and causing a cramping action.

Happily, we have recently found a solution to this problem, which, we believe, meets the requirements fully. We propose installing in the Pitmans a hydraulic connection consisting of a cylinder, piston and transmitting fluid, which are entirely self-contained; i.e., there is no piping external to the device itself. During the advantageous working angle of the crank, the two ends of the cylinder on either side of the piston are sealed off from each other so that a rigid connection is maintained but, as the crank approaches dead center, the two parts of the cylinder are interconnected by means of a valve mechanism, so that the piston is allowed to float freely, thereby permitting the working Pitman to carry the other past dead center, much as is the case with the grasshopper type engine.

This arrangement has the additional advantage of setting a definite limit to the stresses set up in the crank pins, Pitman rods, etc., due to the ability to choose the point at which the load is relieved on the side approaching dead center.

Steel Tug W. J. Harahan Built at Newport News

AN important addition was made to the fleet of Chesapeake & Ohio Railway tugs at Hampton Roads when the *W. J. Harahan* was delivered by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., on April 26. This sturdy little vessel is not only a powerful tow-boat, but an efficient fire fighter as well. She is a steel single-screw harbor tug 109 feet long, 28 feet molded beam, and 14 feet 6 inches depth.

The new boat is the first steel tug to be added to the Chesapeake and Ohio fleet. Her design is largely based on her owners' experience with their wooden tugs *C. E. Graham* and *George W. Stevens*. The hull is of the single-deck type, with straight stem and elliptical stern, and has one smokestack and a wooden pole mast aft to carry the running lights.

Chesapeake & Ohio Railway tug W. J. Harahan

The main deck is of steel, covered with a calked wood deck, and has a heavy steel waist or bulwark, with special rolled steel cap rail, extending completely around it. Four heavy cast iron single bitts are worked through this cap rail on each side of the deck, and cast iron double towing bitts of massive type are fitted fore and aft.

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Heavy pressed steel fenders are riveted to the sides of the tug above the waterline for its entire length, and the upper one is carried around the stern. The main deck house is of steel with the boat deck of joiner construction, canvas covered, laid on top of it. The main deck house contains the galley, toilet and shower spaces, engineers' and mates' quarters, and the upper portions of the engine and boiler rooms.

A wooden pilot house, with captain's stateroom attached, is built on the forward end of the boat deck, and quarters for the crew are constructed of wood below the main deck forward. The hull is subdivided by three watertight steel bulkheads and a watertight transom floor, and contains fore and after peak tanks for fresh water for boiler feed, culinary tank for drinking water, chain locker, engine and boiler rooms, and steel coal bunkers, loaded through chutes from the boat deck.

The framing consists of angles on the transverse system, with plate floors continuous across the centerline, and angle bar keelsons and stringers. Web frames are fitted in the machinery space.

The propelling machinery consists of one compound direct-acting steam engine of 800 to 1,000 horsepower, and one single-ended Scotch boiler, arranged for burning coal under natural draft, with a working pressure of 160 pounds per square inch. The propeller is of semi-steel of the four-bladed solid type. The usual engine room auxiliaries are fitted and there is a complete electric lighting system. Two steam gypsies are fitted forward and aft on the main deck for use in mooring and overhauling towing hawsers. The rudder is handled by a steam steerer located in the engine room, controlled by two brass steering wheels, one in the pilot house and one at the after end of the boat deck.

All quarters are heated by steam, and a sprinkler system is installed over the bunks in the forecastle as a precaution against fires starting in this locality. Two monitor nozzles and connections for 16 lines of hose are fitted as fire-fighting equipment, with a total capacity of 2,000 gallons per minute, for the protection of the owners' dock property. A 600-pound anchor is handled by a davit at the bow.

Oil Engine Cylinders May Suffer While Idle

By O. W. Jennings

IT sometimes happens that the cylinders of a Diesel engine suffer not only for lack of care and diligence in methods of operation and maintenance but through neglect while the engine is at rest.

During normal operation at sea, while the engine works under full load, the cylinder lubrication is reduced to the smallest amount possible to maintain an adequate oil film and an effective seal between the rings and cylinders. This film of oil is necessarily very thin and the characteristics of the oil are such that it is without any particular moisture-resisting qualities. This condition is of no great moment during operation, since the cylinder walls are at a temperature above the boiling point of water and any moisture present would be thrown off in the form of steam which would be carried away with the exhaust gases.

When the engine is shut down and cooling water is circulated in order to congeal the oil on the cylinders and pistons, the temperature of the metal falls below the dew point, and small beads of water, or condensate, accumulate upon the cylinder walls. If the engine lies idle for a few days, this moisture causes rust to form and, when the engine is again started, some time elapses before the rust is completely dissolved with the oil, which is distributed over the cylinder by the piston acting as a huge swab. The minute particles of rust are slightly abrasive, but that does not appear to cause excessive wear. The trouble is that this rust mixes with the carbon and other thick substances of a residual nature and between them all, the rings are prevented from functioning as they should when the engine is started.

The fresh supply of oil will take some time to dissolve these heavy substances and wash them out from between the rings and, until this occurs, cylinders will not be adequately lubricated. This condition manifests itself in large engines of the crosshead type, where the pistons are comparatively short and do not have the large area characteristic of trunk pistons, which will hold upon their surface considerably more oil than will the others.

Action of Lubricant When Starting

When these large engines are started, gases will be heard to escape by the rings with a hissing sound, if the oil film is not well established. The general trend of opinion among engineers, is that the engine needs to be warmed up, after which this escape of gases will cease. That the presence of heat is advantageous in reducing the viscosity of the oil is, of course, unquestionable. However, it is not the only requisite.

Rings and cylinders without oil will not maintain an effective seal, regardless of temperature. On the other hand, they will maintain such a seal if adequately lubricated, even though they are quite cold. To operate these engines, even for a short period of time, without having a suitable oil film must do some harm in the form of excessive wear to the cylinders and rings.

A solution of this difficulty does not lie in shutting off the cooling water before the engine has been cooled down, for it would eventually cool off even though it were left to stand hot. In the meatime, the heat would reduce the viscosity of the oil and cause it to drip out of the space between the piston and cylinder walls and from between the rings, whereas, to cool these down as soon after stopping the engine as is consistently possible, will cause the oil to congeal and remain upon them, which is common practice.

It is not the customary practice on all ships to flood the piston with oil just before stopping the engine, but this should be done. By feeding an abundance of oil, while maneuvering, a two-fold advantage is attained; rust will be prevented and there will be ample lubrication present when the engine is again started.

Intermittent Operation

Carbonization of the oil is not likely to occur during maneuvering, since intermittent operation of the engine prevents the high temperature characteristic which develops while working steadily under full load. It is not possible to have too much oil on the pistons, as the result of over lubrication at this time, for, in addition to the low temperature, a certain amount of oil drips off the pistons between maneuvers and a considerable amount drips down after the final stop, no matter how quickly the engine may be cooled off. Actual demonstration has proved that to over-lubricate at this time will prevent rust while the engine is idle and leave it in a more effectively lubricated state, and in better condition for the final start, upon maneuvering out of port.

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Propeller Drive for River Towboats

New stern and rudder system improves maneuvering ability of screw-driven towboats

FOR many years various attempts have been made to use propeller-driven towboats in the shallow waters of the western rivers. It has been recognized that the direct connection of Diesel engines to propellers offers a much simpler type of drive as compared with the stern wheel with its various types of reduction gear. One of the difficulties in the use of propellers has been in the design of a suitable arrangement of rudders which would give the excellent maneuvering qualities of the stern wheel drive. Another difficulty encountered in the use of propellers is the protection of the propellers and the rudder system in very shallow water. Driftwood, snags and shoals have also increased the danger to screw operated vessels.

A solution of this problem has been offered in a new type of stern and rudder arrangement which has been invented by Captain Phil C. Elsey, master of river transportation of the Vesta Coal Company, a subsidiary of the Jones & Laughlin Steel Corporation. The Vesta Coal Company is one of the pioneer towing companies on the western rivers and has made a number of important contributions in the construction and operation of river towboats, one of the most important being the first application of the Trojan drive for stern wheel towboats.

In developing a stern and rudder arrangement which would give the screw-driven boat characteristics equal to, or better than, the stern wheel towboat Captain Elsey has patented a unique arrangement. Fig. 1 shows a suggested application of the system to a towboat with three 500 horsepower Fairbanks-Morse Diesels.

It will be noted that the after underwater body of the hull is tapered to a point. Then the upper portion of the hull continues to the stern, curving up slightly to provide space for the rudders and propellers. Two rudders, called the flanking rudders, are placed ahead of the screws and three rudders are placed behind the wheels. When going ahead the water from the propellers impinges against the rear rudders and when

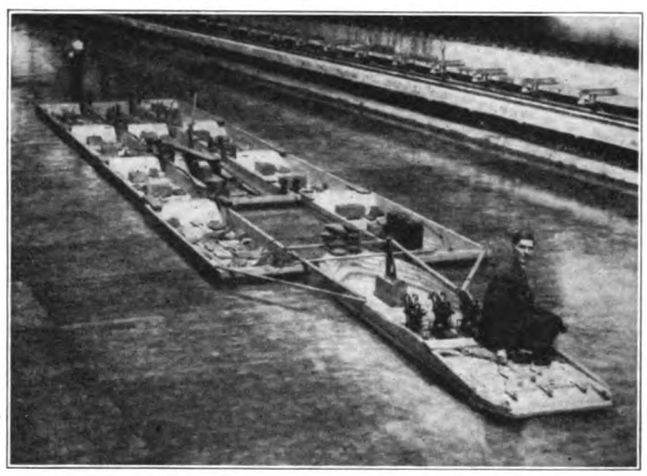

Fig. 2.—Model being towed in basin

flanking, with the wheels going astern, the water is forced against the front rudders. The wheels and the rudders are protected by skegs which project downward at each side of the hull. These skegs and the tapered part of the hull form the flank tunnels, which are the secret of the rudder power. When the front rudders are swung over to either extreme position the water from all three propellers, when flanking, is directed through one of these flank tunnels. One of the front rudders blocks off its flank tunnel and so all of the water must flow out through the other tunnel.

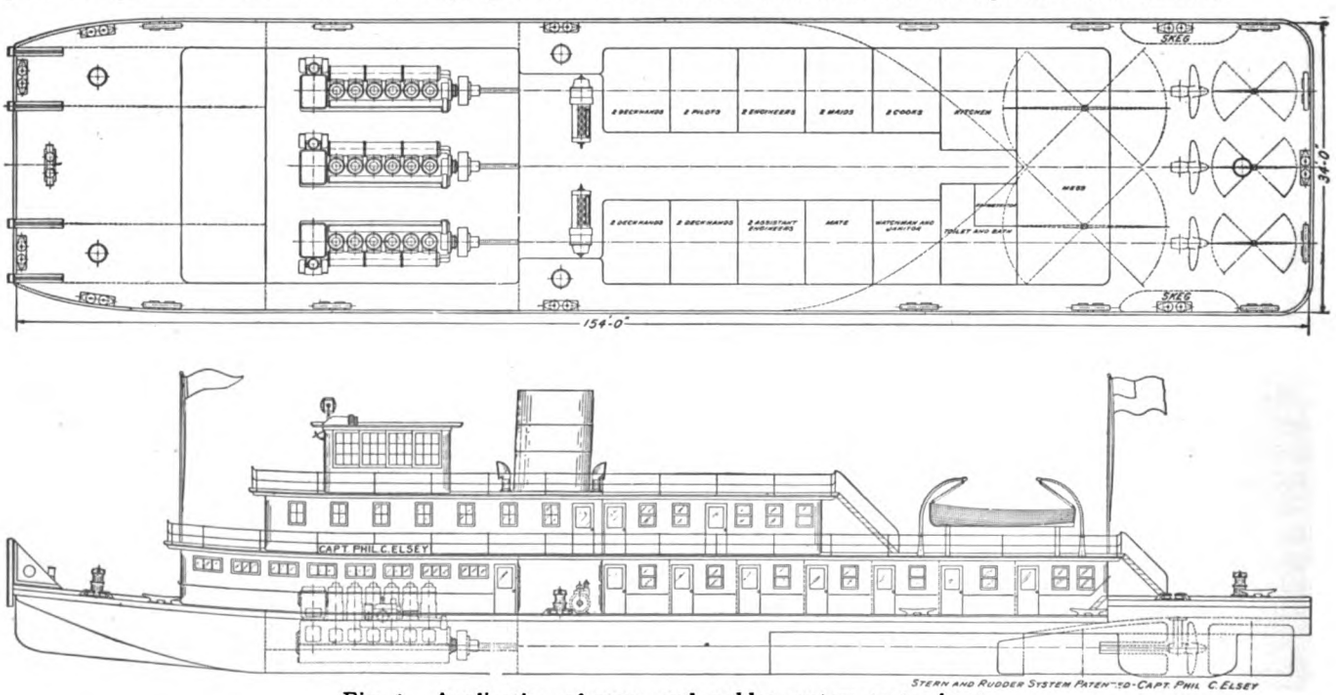

Fig. 1.—Application of stern and rudder system to towboat

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The tapered portion of the hull thus assists in the flanking action. In the ordinary type of hull the water tends to pile up against the hull when flanking and even if rudders are placed ahead of the wheels they give only very slight flanking power.

The skegs, in addition to forming the outer walls of the flank tunnels, also protect the rudders and the wheels when shoal water is encountered or where the flanking carries the stern into the bank. Protection against driftwood is especially important when flanking and this protection is secured because the rudder which closes the flank tunnel keeps the driftwood away from the propellers.

The front rudders are of the balanced type and are slotted so as to clear the propeller shafts. In passenger vessels the after portion of the hull would be bevelled but in towboat practice, where power rather than speed is desired, the portion of the hull that forms the flank tunnels cuts off sharply in a vertical curved surface.

The scheme is also applicable to stern wheel drives as it increases the flanking power of the stern wheel drive.

Recent tests of a working model at the model Basin at Washington, D. C., have very strikingly demonstrated the maneuvering qualities of Captain Elsey's rudder system. The model (Fig. 2), driven by three screws operated by motors and a storage battery, was hooked up to barges, also constructed to scale and representing a tow of 10,000 tons. The head of the tow responded instantly to flanking movements.

Plans for building several towboats with this rudder and stern arrangement are now in the tentative stage and their development will be watched with considerable interest by river men. The Fairbanks-Morse Diesel engine division and research division, in conjunction with Captain Elsey, have drawn tentative plans for the 154-foot towboat shown in Fig. 1. This vessel, with three 500 horsepower Fairbanks-Morse Diesels, would handle a tow of 10,000 tons and would greatly exceed in size any towboat on the western rivers. With a capacity of two hundred 50-ton railroad cars or five train loads, it would form an important addition to the capacity of the Vesta Coal Corporation fleet.

With the improvement of the internal waterways, craft of this type should occupy an important place in low cost river transportation.

Critical Speeds — III*

By F. McAlister, A.M.I.N.A.

IT IS proposed in this, the concluding article of this series, to apply the methods given in the preceding articles to the determination of the relationship between coefficients of fineness and economical speeds.

The economical speed for a given form has had many definitions in the past. Authorities have variously defined it as the speed at which the horsepower is varying as the fourth power of the speed; Taylor in his "Speed and Power of Ships" states that "experience appears to indicate that few good designers adopt coefficients and proportions for slow speed ships such that the residuary resistance is much over 30 percent of the total," while Lovett, in his paper before the Institution of Naval Architects in 1922 mentions that he deduced the block coefficients advocated in his paper from direct observation of the (C) curves from model results, the limit of economical propulsion in each case being the speed value midway on the first definite steepening of the (C) curve.

The latter statement, although seemingly definite enough, is capable of misconstruction, and a search must be made to see whether there is any fundamental relationship between the known factors underlying this definition of economical speed. It was shown in the second article of this series that the first definite steepening on the resistance curve for Kent's model 111D was attributable to the synchronism of the trough of the residuary bow wave with the initial trough in process of generation at the position of the bow defect of pressure. This being the case, it is possible to enunciate the following: In a vessel of average dimensions, the limit of economical speed is determined by the position of the hump due to bow interference, this in turn being governed by the length and fineness of the entrance of the vessel.

The economical speed of a vessel in knots may then be represented by the following relationship:

$$Ve = 1.34 \sqrt{\frac{Le \times w}{\frac{1}{2}}},$$

$$= 1.895 \sqrt{w} \sqrt{Le}.$$

w is then dependent upon the prismatic coefficient of the entrance.

We will take as an example a vessel having the following principal particulars:

L	400.0 feet
B	50.0 feet
d	25.0 feet
ϕt	0.78

A large number of vessels of about this fullness appear to have a practically constant prismatic coefficient of entrance of 0.68, and, assuming in the above example that this is the case, we can determine the length of entrance necessary to balance the prismatic coefficients of entrance and total ship.

Assuming, then, that the prismatic coefficient of the run is equal to that of the entrance, and that the center of the parallel body is coincident with the midship section of the vessel, we have

$$\gamma = \frac{(\phi t - \phi e)}{(1 - \phi e)} = \frac{(.78 - .68)}{(1 - .68)} = 0.313.$$

$$Le = \frac{L(1-\gamma)}{2} = \frac{400(1-.313)}{2} = 137.4 \text{ feet.}$$

$$w = 3(1-\phi e)^2 = 3(1-.68)^2 = 0.307.$$

and $$Ve = 1.895 \sqrt{w} \sqrt{Le} = 1.895 \sqrt{.307} \sqrt{137.4},$$
$$= 12.32 \text{ knots.}$$

which would be the economical speed for the vessel in question.

On the assumptions stated we can frame the formula so as to give the economical prismatic coefficient in terms of speed. Thus

$$\frac{Le}{L} = \frac{L\left\{1 - \frac{(\phi t - .68)}{.32}\right\}}{L \times 2} = \frac{(1-\phi t)}{.64}.$$

$$\therefore \frac{Ve}{\sqrt{L}} = \frac{1.895 \sqrt{w} \sqrt{Le}}{\sqrt{L}} = 1.312 \sqrt{1 - \phi t}.$$

* The first article of this series was published on page 291 of our May, 1927 issue and the second on page 44 of our January, 1928 issue.

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from the foregoing formula the following may be derived:

$$\phi t = \left(1 - .58\frac{V^2}{L}\right)$$

and this is the final formula for economical prismatic coefficient. For ease in application, values of the prismatic coefficient have been calculated for various $V \vee L$ values and are shown in graphical form in Fig. 1. In

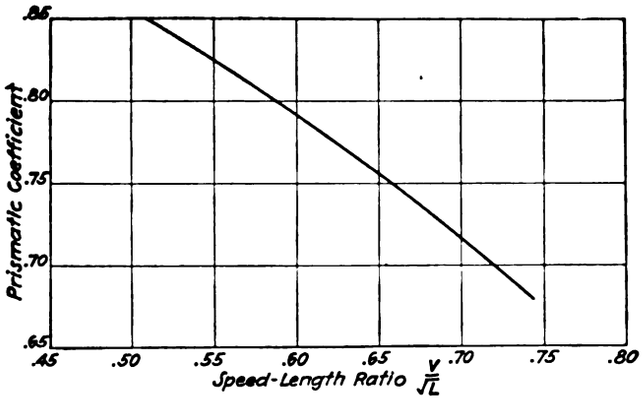

Fig. 1.—Economical prismatic coefficient in terms of speed and length of vessels of ϕ ends=0.68

this form it will be convenient for the designer to plot his own data on the diagram, to indicate the field covered by such information.

In comparing the above formula for economical speed and fullness with those already existing for the benefit of the practitioner reference may be made to a paper read by Mr. (now Prof.) Hillhouse,* in which, for vessels having block coefficients varying between the limits of 0.56 and 0.78 and having an average value of 0.61 for the end prismatic coefficient, he gives, as the result of his analysis of successful vessels, the limiting economical speed as

$$Ve = 0.925\sqrt{E.}$$

where E is the combined length of entrance and run. Assuming that the length of the entrance is equal to the length of the run we have

$$Ve = 0.925 \vee 2Le = 1.308\sqrt{Le.}$$

From the formula presented in this series of articles we can determine the economical speed for a vessel of this family having an entrance prismatic coefficient of 0.61, and compare it directly with the Hillhouse formula of $1.31 \sqrt{Le.}$

$$\text{Thus} \quad w = 3(1-.61)^2 = 0.456$$

$$\text{and} \quad Ve = 1.34\sqrt{\frac{\sqrt{Le \times w}}{\frac{1}{2}}} = \frac{1.34\sqrt{.456}\vee Le}{\sqrt{\frac{1}{2}}},$$

$$= 1.28\sqrt{Le}$$

which is in close agreement with the Hillhouse formula.

In Mr. Lovett's paper of 1922 which has been previously referred to, he gave a table of block coefficients for various proportions of beam to length and different speed length ratios. For the vessel of average proportions shown earlier in this article, where the prismatic coefficient was 0.78, the block coefficient for use in obtaining Lovett's economical speed would be, assuming a midship section coefficient of 0.98, equal to 0.764. For the L/B ratio of the example, i.e. 8.0, and the block coefficient as stated, the economical speed length ratio would be 0.615, which is equal to a speed of 12.30 knots, the calculated economical speed of 12.32 knots being in close agreement with Mr. Lovett's.

The coasting class of vessel is often referred to as being an overdriven type of vessel, so it will be of interest to investigate the type and see whether this generalization can be qualified. Among the writer's information there are particulars of a typical coaster designed for 10¾ knots speed, loaded trial. The length was 195 feet, the block coefficient 0.65, and for a midship section coefficient of 0.97 the prismatic coefficient would be 0.67. The length of entrance could be assumed as half the length of the vessel, i.e. as 97 feet 6 inches, as there would be no parallel body.

$$\text{Thus } w = 3(1-.67)^2 = 0.327$$

$$\text{and } Ve = 1.895\sqrt{w}\vee\overline{Le} = 1.895\sqrt{0.327}\ \sqrt{97.5}$$

$$= 10.72 \text{ knots.}$$

This economical speed by formula is so close to the designed speed of 10.75 knots that it is possible to state that the formulæ given in this series of articles cover particularly this type and, generally, all types of vessels.

It is hoped that the methods outlined in this series of articles will clear up some of the obscure points in the literature of critical speeds, and serve a useful purpose in guiding the practioner in the region of the economical limits of speed and fullness.

* Institution of Engineers and Shipbuilders in Scotland, 1910.

Airplane Carrier Lexington Makes Record Speed

FIVE world speed records for ocean-going vessels were left in the wake of the navy's new airplane carrier *Lexington* when she arrived in Honolulu Harbor on June 12.

Speeding across the Pacific at an average speed of 30.7 knots, the *Lexington* had shattered three records, in successive days for miles traversed in 24 hours; lowered by more than three hours the record time of passage to Honolulu, and established a new mark of miles steamed in three successive days. The vessel was aided by smooth seas and favorable weather conditions during the entire trip, which was made in 72 hours and 34 minutes.

Maximum Power Not Developed

These records were made without her maximum horsepower of 180,000. She undertook the voyage to join the battle fleet without part of her turbine blading, which had been removed because of defects.

The distance covered by the vessel was 2,228 nautical miles, from San Diego to Honolulu. The previous record for the voyage was made by the light cruiser *Omaha* in 1923, when she covered the 2,091 nautical miles from San Francisco light vessel in 75 hours, 40 minutes and 40 seconds.

During the first 24 hours of her voyage, which began about noon June 9 the *Lexington* made 700 nautical miles, surpassing the record of the *Omaha* made during her 1923 voyage when she covered 690 miles. On the second day the *Lexington* logged 742 nautical miles exceeding her performance of the first day and establishing a new record. The third day she steamed approximately 770 miles to better her marks of the previous two days and to attain an additional record for miles covered in three days.

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Oil Engine Power Conference

Marine applications of the Diesel engine— Fuel oil specifications — The advantage of specializing in production of parts

THE first national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers and the second annual Oil Power Conference of the Pennsylvania State College were held jointly at State College, Pa., June 14 to 16. A number of the papers delivered at the meetings have a bearing on marine oil engine practice and such parts of the papers as apply specifically to this service are abstracted in the following:

Economic Field For Small and Medium Size Diesel Engines

By Harlan A. Pratt*

The fundamental reason that the Diesel engine has taken, and will continue to take, its place in industry and transportation is that it is the most efficient converter of the latent heat energy in fuel into active mechanical energy. Its thermal efficiency, which is the ratio of heat utilized to heat contained in the fuel, is approximately 33 percent and this is true even in horsepowers as low as 25 to 50. This ratio of useful energy can be considerably increased in certain cases by the utilization of the waste heat in exhaust heaters, boilers and exhaust turbines. Under such conditions the thermal efficiency may be increased to over 50 percent.

In the marine field the Diesel engine has quickly forged to the front; for example, over 50 percent of the world's ship construction in the years 1926 and 1927 was equipped with oil engines. Confining ourselves to the discussion of the smaller units, we find the ships that take these units today are the fishing boats, tug boats, work boats, ferry boats, small lighters, dredges, yachts, coast patrol, etc. It is almost safe to say that no boats in this class are built without considering the use of a Diesel engine. These sizes of Diesel engines are particularly applicable to marine work, as they show in the majority of cases great economy over any other power. The saving in fuel alone generally justifies the cost of the Diesel engines, and this saving in many cases can be augmented by a saving in the crew.

Unusual results have, for example, been obtained in tug boat service. A recent installation of two 350-horsepower Diesel engines in the Diesel-electric tug, *Meitowax*, owned by the Long Island Railroad, was compared with a modern steam, oil-burning tug of the same size, and operating under the same conditions, on a 24-hour test. The figures published showed a daily fuel consumption on the Diesel tug of 480 gallons (cost, $24), and on the steam tug a fuel consumption of 2,314 gallons, (cost, $104); a ratio of 4 to 1. Furthermore, a saving of $14.28 per day was made in the crew, the total saving on wages and fuel being estimated at over $30,000 per year. In addition, there is the great convenience of taking on fuel only once in 15 days, instead of once every 3 days.

Today a user of power should carefully consider the Diesel engine. In addition to the high thermal efficiency, the reliability, the practical mechanical construction, and the satisfactory operation of representative makes of Diesel engines are giving more and more confidence to prospective purchasers.

Factors Influencing Diesel Installation

The endeavor of this paper is not so much to discuss actual cost of developing a horsepower-hour, or a kilowatt-hour, with the Diesel engine, as to lay down the fundamental factors determining the desirability of installing Diesel engines.

As a rule, load factor is the determining feature as to whether or not a Diesel engine should be installed. The peak load requirements will decide the size of the power plant. The careful determination of the load factor and number of hours of operation will give the total power units to be produced in a given time. The two fundamentals, size and cost of the Diesel plant and the number of units of power to be produced, having been determined, the actual cost of the energy can be computed.

The cost of producing power will be made up of the following items: Fuel oil, lubricating oil, labor, maintenance and capital charges. The correct analysis of these factors will determine the cost of the Diesel power in comparison with other available power.

As yet there is a lack in the Diesel engine industry of readily available data that are both reliable and convincing to the prospective purchaser. To correct this situation the industry should take steps to gather together all present available information, of which there is a considerable amount. Aid, for example, should be extended to the power cost committee of the Oil and Gas Power Division of the American Society of Mechanical Engineers in its work of collecting data on the cost of producing power in existing Diesel plants. All these data should be properly arranged, officially approved, and authoritatively circulated. Such a step would set an epoch-making mark in the progress of Diesel engine expansion.

The Economic Field for Large Diesel Engines

By Edward B. Pollister*

In considering the economic field for large Diesel engines in this country, it is important to note that the successful performance of large marine Diesels was a vital feature in the decision to go ahead with the 12,000 horsepower Panama Canal power plant; and the rapid adoption of the Diesel for the propulsion of ships has eliminated what might be the fear of experimental development by possible purchasers of large land Diesels. The largest motorship in service, the *Augustus*, of 32,500 gross tons, is propelled by Diesels totaling 28,000 horsepower. The proposed reconditioning of the Shipping Board vessel *Mount Vernon* calls for two propelling Diesels of 14,500 brake horsepower each, and a total Diesel plant of 35,000 to 40,000 brake horse-

* Manager, oil and gas engine departments, Ingersoll-Rand Company, New York City.

* General manager, Busch-Sulzer Bros. Diesel Engine Company, St. Louis, Mo.

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power. These large engines can be furnished in the same American-built cylinder sizes as are now successfully operating in round-the-world marine service. The following survey as of December 31, 1927, of marine

Steam Engines				Oil Engines	
Reciprocating		Turbine			
No.	I.hp.	No.	I.hp.	No.	I.hp.
327	556,874	34	343,700	352	1,233,956
Average size	1,700		10,000		3,500
Total gross tonnage under construction				Steam.....	1,494,532
				Diesel.....	1,609,888

engines under construction throughout the world discloses that the aggregate horsepower of Diesel engines building or being installed is over 3 times that of steam turbines (excluding Germany—figures not available), and that the tonnage of motorships now building is greater than that of steamships.

The trend toward Diesels is indicated by a statement issued in April of this year by Lloyds Register of Shipping for the first quarter of 1928, showing a gain to March 31, 1928, of oil engines to 1,333,875 indicated horsepower compared with a decline of steam turbines (excluding Germany) to 277,600 indicated horsepower, and a decline of steam reciprocating engines to 549,910 indicated horsepower. This ratio of 5 to 1 for marine Diesels as compared with steam turbines demands the serious attention of designers of land power plants.

Diesel Fuel Oil Specifications

By G. H. Michler*

The growing importance of the Diesel engine as an economical power unit cannot be overestimated. In one of its principal fields, the marine trade, its growing ascendency over steam power plants is attested to by Lloyd's marine construction figures for the year 1927, which reported that for the first time in history world wide construction of Diesel ship tonnage exceeded the construction of steam tonnage.

In Europe where the construction of motor vessels is considerably more advanced at the present time than in this country, motorship construction during the year surpassed steamer construction by about 200,000 deadweight tons. This represented a considerable advance in Diesel construction over 1926 in which 925,837 deadweight tons of steamers were constructed as compared to only 701,777 deadweight tons of motorships.

When we consider that the fuel consumption in these large units bears a ratio of 1 to 3 as compared to fuel oil burned by steamers under boilers to develop the same horsepower in comparable tonnage, the importance of the Diesel engine as a factor in conserving the future world oil supply can be appreciated. Its advantage to the operator, particularly of freight ships, on long trade routes, is decided. His fuel consumption is materially decreased, making available more space in the ship for freight earning cargo and requiring him to make less stops for fueling purposes.

Everything apparently justifies the operators' investment in a comparatively high priced piece of mechanism (in this country at least) but there is, as usual, a difficulty. In this case it is the various types of Diesel oil required by different engine builders and passed on by them to operators as a basis of performance guarantees.

Let me cite some examples: A couple of years ago a motorship made her maiden voyage from a United Kingdom port to the United States. The following is comparison of oil supplied the vessel in the United Kingdom and oil supplied by our company at New York:

	United Kingdom Sample	New York Sample
Gravity at 60 degrees F.	26.7	30.2
Flash, Pensky-Martens closed cup	175 degrees F.	175 degrees F.
Viscosity, Saybolt at 100 degrees F.	98 seconds	50 seconds
Sulphur, bomb method	1.34 percent	0.4 percent
Carbon residue	3.05 percent	0.4 percent
Asphalt, Italian tar test	45 percent	6 percent
Ash	none	none
British thermal units per pound	19,125	19 400
Water and sediment	trace	trace

At the time of delivery, our knowledge of requirements of marine Diesel engines led us to believe that the oil furnished by us was superior to that furnished on the other side and we believe that most Diesel engine manufacturers would be of the same opinion. This is apparently borne out by the specifications issued by marine Diesel engine builders from time to time.

In actual operation of the vessel, however, serious trouble was encountered and all of the trouble was laid to the oil by the operators of the motorship. As an experiment, we mixed 40 percent of a heavy residue oil with Diesel oil which had the result of reducing the gravity, increasing the viscosity, sulphur content, coke residue and very materially increasing the asphalt content by what is known as the Italian tar test, also reducing the British thermal units per pound. In other words, the oil was brought to what we consider a poorer quality and made to conform more nearly to the grade of oil delivered in the United Kingdom which appeared to operate successfully. Whether the trouble was due to the grade of oil delivered or mechanical troubles of the engine we are not in position to say. Under any circumstances, the operators claimed that by blending what we considered an inferior oil, their troubles were overcome. This is only one illustration of the difficulties we have encountered.

Lack of Standard Specifications

One of the largest customers of the company which I represent who buys a considerable volume of Diesel oil for his ships at North Atlantic and United States Gulf ports insists on various specifications for different ships, although all of them were engined by the same company in Europe. For some of his vessels he requires a maximum sulphur content of ¾ of 1 percent, and minimum API gravity of 26 degrees. For other vessels he limits the maximum sulphur content to only ½ of 1 percent and stipulates that gravity shall not be below 27½ degrees. These specifications are drawn in accordance with the guarantee of the engine builder. Vessels with engines of the same make have operated successfully for years on the west coast on an oil with a sulphur content of over 1 percent and gravity at times as low as 24 degrees. For several years our company had a contract with another ship operator who required Diesel oil of minimum gravity of 33 degrees API. Builders' specifications were given again as the reason.

Fuel Requirements of Engine Builders

It is natural that Diesel engine builders should wish to insure a supply to their engines of fuel oil ideally suited for their best performance. It is further natural that in the course of evolution, through which any new type of machinery must advance towards perfection, there should be a wide variation in the ideas of different manufacturers as to what constitutes a suitable fuel for their particular engine. One present phase of evolution is that manufacturers are endeavoring to construct engines that will operate on heavier oils. In

*—Fuel oil division, Standard Oil Company of New Jersey, New York City.

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doing this, it seems that these engines will not operate on lighter grades of oil such as are considered more desirable for other engines. Each manufacturer seems to have a different idea of the grade of oil required for his particular engine. Sulphur is sometimes blamed for all troubles encountered and some manufacturers, as mentioned previously, are requiring that oil should be used containing not more than ½ of 1 percent sulphur. It is our view that to limit sulphur to this low percent is unnecessary and it is further our view that a great many other specifications are unnecessary.

As we see it, the successful development of the Diesel engine is dependent on a supply of Diesel engine fuel oil at the lowest possible price. The main obstacle in the future to a reasonable price is the lack of a standard Diesel oil specification with sufficient flexibility to permit refiners to utilize crudes from various sources and to carry one grade of Diesel oil in tankage at different points. Unless this is done, the future progress of the Diesel engine is going to be very materially handicapped. This handicap will be twofold; in the first place, the cost of manufacturing, handling and storing a variety of different grades of Diesel oil may cause the price to mount to a point that would destroy the economy which rightly belongs to the Diesel engine due to its low fuel consumption. In the second place, unless Diesel engines are constructed which can operate efficiently on a standard grade of Diesel oil of broad specifications, ship operators will be unduly restricted to limited points of fuel supply. This feature might easily preclude their operation in the most desirable trade services.

From the standpoint of oil companies the question of specifications is considerably simplified if they are limited to three—minimum gravity, sulphur content and flash. With regard to the first, it is our feeling that a minimum gravity of 24 degrees API should be generally satisfactory. We believe that maximum sulphur content of 1½ percent should be acceptable. Minimum flash of 150 seconds, closed cup has always been the standard.

Specialization in Manufacturing Diesel Engines

By O. D. Treiber*

The Diesel engine industry has today a good supply of specialty products to draw from such as bearings, piston rings, drop forgings, castings, crank shafts, valves, cams, springs, pistons, gears, governors, lubricators, pumps, gages and valves, all of which are more or less common to many types of engines. Prices of these products to the manufacturer are in many cases satisfactory and such as to discourage the engine builders from trying to manufacture them themselves. However, there is a splendid opportunity for improvement.

The Diesel engine business is settling down to a more stable and well organized business. The ability to obtain specialty products from various shops will undoubtedly have a tremendous bearing on the reduction of Diesel engine costs and should be encouraged. There will undoubtedly continue to be different designs of items such as fuel oil pumps and spray nozzles. However, these generally require about the same tools and shops should organize themselves for producing such things, even in small quantities.

The various parts of the Diesel engine can be classified into a reasonable number of groups such as parts which are hardened and ground, parts made on screw machines, automatics, parts made from large forgings such as crank shafts and connecting rods, parts made from small iron castings, parts made from large cast iron castings, parts made from aluminum. Another item is piston rings; still another is bearing shells. Another separate classification could be cylinder heads and liners.

Progress in the Diesel engine building art has been rapid in the last few years, but production will never be as intensive as in the automotive business. However, specialty shops can contribute their portions to the economies of Diesel engine construction in maintaining a high class organization of mechanics who are taught to do different kinds of jobs economically. This policy is of necessity exercised in the Diesel engine manufacturer's shop because of the lack of high production of any given size and if it can be worked out efficiently in the builder's plant it can also be done in the specialty shops. Take, for instance, the matter of spray nozzles. There are probably 25 different kinds of spray nozzles today built in as many different shops. Probably there is not sufficient production in any one shop to tool up for high production. However, should the construction of all of these spray nozzles be confined to one shop and one organization, there are a great many of the operations such as heat treating and grinding, assembling, testing, etc., that could be done much more economically resulting in larger savings to the ultimate purchaser.

* Treiber Diesel Engine Corporation, Camden, N. J.

The Importance of Properly Balancing Turbines

By Earle S. Nason*

SINCE the advent of the steam turbine for marine service it has been demonstrated that the rotative parts require careful balancing. The speed of a turbine is high and a small excess of weight on one side may develop a great pressure on the bearings or a heavy and serious strain on the shaft. For example, a weight of 1 ounce on the rim of a turbine wheel 4 feet in diameter, making 1,200 revolutions per minute, will cause a lateral pressure of 62 pounds. The same wheel, if 0.01 inch out of true, will generate a lateral pressure of 400 pounds. If a piece of metal weighing 1 pound be secured near the rim on either flat surface, there is a centrifugal moment of 750 pounds times ½ the thickness of the disk. It is necessary that all centrifugal forces and couples should be eliminated, to which end the ordinary methods of balancing are not always sufficient.

All rotating parts of machinery, and especially turbines, should be in perfect balance. If they are not in balance, they will vibrate and cause damage by the moving blades coming in contact with the stationary parts of the turbine. The vibration may even cause the blades to break off without actual contact.

Static and Dynamic Balancing

Two balances are required to insure a steady running rotor. These are static balance and dynamic balance. Lack of static balance is due to the axis of rotation not passing through the center of gravity of the rotor and causes the rotor to vibrate when in operation. Lack of dynamic balance is due to an unbalanced centrifugal

* Chief machinist, U. S. N., Boston Navy Yard.

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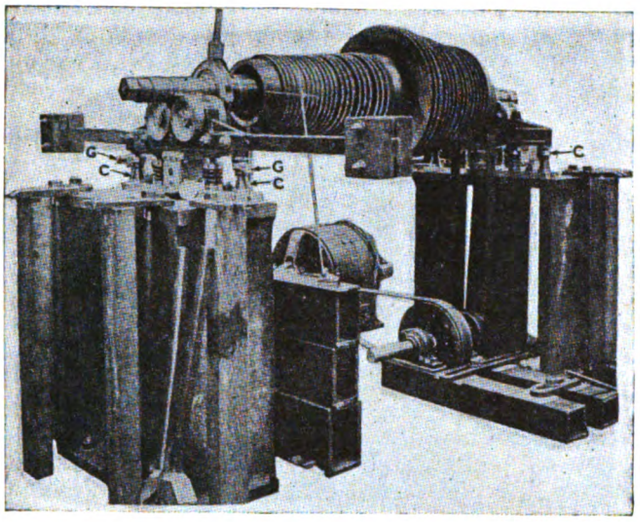


Turbine rotor undergoing balancing operation in Akimoff machine

couple in the rotor which can only be balanced by another couple and not by a single weight.

A short time ago an interesting repair job of reblading the low pressure turbine of a large steamship while it was in place on the ship was carried out in the Port of New York in a record time of four and one half days. This was a very creditable performance. No doubt the aim in performing the work of reblading in place was to save time, labor and expense.

In view of the fact that the work of reblading was performed in place, a perfect balance could not have been made. The result of this work will be exceedingly interesting after the ship has made several trips. When her turbines were built, there is no doubt but that the builders balanced them perfectly, having the latest instruments of precision available for this work.

Since the turbine was rebladed, however, the distribution of weight is not the same, although it may approach this condition, due to perfect machining of blades and other parts, which were probably fabricated from drawings of the original installation. The true condition of balance, critical speeds and excessive periods are not known and cannot be determined until a turbine has been operated under actual running conditions. The question therefore arises, will this ship develop any critical periods or excessive vibration in her cruising speed or at any other speed at which she may be required to operate?

Determining the Critical Speed

In order to obtain the satisfactory maximum speed at which to operate the main propulsive turbine of a mechanical geared installation which gives trouble due to vibration, the shaft coupling abaft the main gear can be disconnected and the turbine spun with steam. In this way the critical speed as well as the speed at which vibration becomes serious may be readily and accurately determined. This procedure should be carried out while the ship is at anchor or secured to a dock.

It has always been considered the best engineering practice to properly balance turbine rotors after any work has been performed where there has been the slightest change in the distribution of weight. In order to accomplish this it is necessary to remove the rotor from the ship and balance it ashore.

The illustration shows a turbine rotor in an Akimoff balancing machine. The roller bearings at each end are carried on a flexible support which permits them to vibrate in case the turbine vibrates due to being out of balance. The vibration may be damped by means of springs underneath the arms which carry the roller bearings. If desired, the bearings may be clamped rigidly by means of the clamps *C*. When balancing, one end is always clamped while the other is allowed to vibrate.

Measuring Extent of Vibration

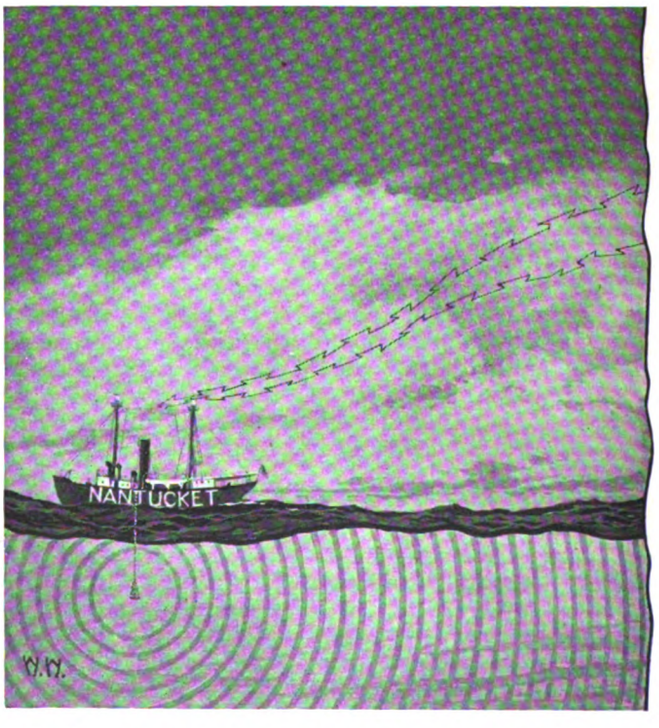
Dial gages are mounted on the foundation and connected to the arm which carries the bearings. These gages are shown at *G* and give a relative measure of the extent of vibration. The movable clamp and the adjustable weight which it carries are plainly shown in the illustration.

The writer has seen turbines rebladed in the Navy Yard at Boston, Mass., where blades and other parts checked with the original drawings, giving an impression that the weight distribution was almost the same as in the original rotor installation. In such cases it has actually taken from three to five days to balance the rotors on an Akimoff balancing machine, requiring the shifting of weight several times in order to obtain a perfect balance.

Until successfully proven that the element of chance has been eliminated, engineers should hesitate to have turbines rebladed in place without properly balancing them, expect in a case of emergency where time is the chief factor.

Distance Finding

AN interesting development tending toward greater security of navigation in times of fog and poor visibility is the system of synchronous signaling known as distance finding, developed by the Submarine Signal Corporation, Boston, Mass. Radio



Radio and submarine signals sent out from lightship simultaneously

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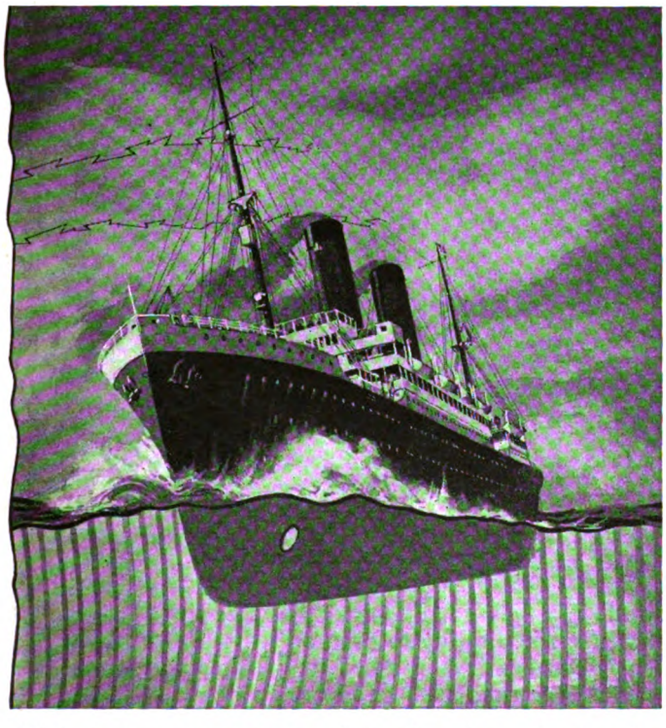
direction finding and submarine signaling, the two aids to navigation, which, in combination, produce distance finding, are at their greatest point of usefulness when used conjunctively, because by providing a knowledge of distance and bearing from a definite point, they provide a knowledge of position. Moreover, such a method of position-finding is convenient and economizes time because only one station is used in making the observation.

The principle underlying distance finding is simple. To illustrate, if we know the velocity of a traveling object in addition to knowing the time at which the motion commenced and the time at which the object was intercepted, we have all necessary data for computing the length of the path traveled, or, in other words, the distance.

Distance finding is accomplished in precisely the same manner. The traveling "object" is the signal of the submarine oscillator. The velocity of this signal in water is known, and the time at which the signal commences to "travel" from a lightship is made known to the listening navigator by so joining the code machines of the radio beacon and submarine oscillator on the lightship that a warning radio signal is sent out simultaneously with the oscillator signal. For all practical purposes, the radio signal amounts to instantaneous notification that the oscillator signal has been sent out, for radio waves travel at the rate of 186,000 miles a second. The time at which the "object" is intercepted is, of course, the time at which the submarine oscillator signal is heard by the listener.

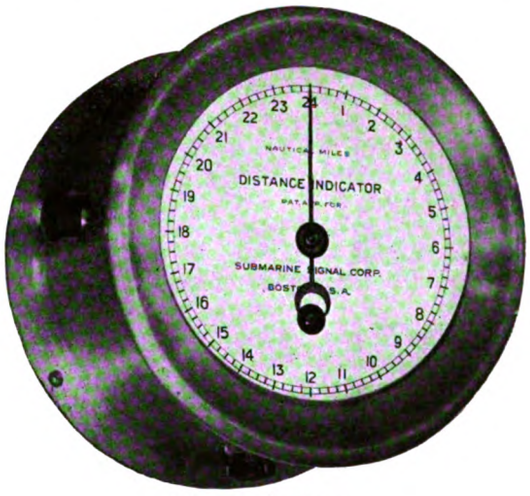
Without going into detail, it is sufficient to say that the above procedure is simply the reverse of the method employed by Colladon and Sturm on Lake Geneva to determine the velocity of sound in water. Their known factors were distance and time, and the unknown factor was velocity. In distance finding, the known factors are velocity and time, and the unknown factor is distance.

If an elementary method were used in taking advantage of distance finding, the procedure would be as follows: At the moment that a listener hears the radio signal, he would start a stop watch; on hearing the oscillator signal, he would stop the watch and note the time interval. Then, multiplying the time interval by 0.8, he would know the distance between his ship and the lightship, for sound travels approximately 0.8 mile per second in sea water.



Time interval between reception of radio and submarine signals on liner indicates distance between ships

In actual practice, no computations whatever are necessary as a device called a submarine distance indicator is installed on the receiving vessel. Thus, the entire operation consists only in pressing a button when the radio signal is heard, and releasing the button when the oscillator signal is heard.



Distance indicator

Then, a glance at the position of a pointer on the dial is all that is necessary to complete the distance finding operation. The submarine signal apparatus or the radio compass will also give the bearing. Hence, the position of the ship is known.

Very few changes are needed in the existing apparatus on lightships and commercial ships in order to provide and take advantage of the distance signals. On lightships equipped with a radio beacon and a submarine oscillator, a simple combination of the code machines of the radio beacon and submarine oscillator is all that is necessary. On commercial ships equipped with radio and submarine signal apparatus, the only change necessary, besides the addition of the distance indicator, is to run an inexpensive line of cable between the distance indicator and the radio compass or communication wireless set. Often, it is even unnecessary to run this extra line, because, on many ships, the distance finding apparatus is connected to the line used for obtaining the radio time signals.

Signals Heard 50 Miles Away

The signals of the distance finding stations have been heard at distances greater than 50 miles. Observations at ranges of from 30 to 50 miles are common. Such a range is possible because the device used to produce the underwater signal, the submarine oscillator, is the most powerful known means of producing underwater sounds. This device first came into prominence during the world war as a means of communication between men-of-war and submarines. More than 400 submarine oscillators were installed on warships before and after the war period, and today practically every submarine vessel in service is equipped with an oscil-

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lator. The use of the oscillator for submarine signaling and distance finding followed as a natural consequence of its great usefulness on naval vessels.

It is interesting to note that the Old World has taken the lead in equipping lightships and shore stations to give to shipping the added protection of distance finding. In 1923, the only stations equipped in this manner were Nantucket Lightship, and Maas Lightship in Holland. Since that date, the total number of stations has increased to twenty and other stations are expected to go into operation very soon. Germany was the first country to adopt distance finding on an extensive scale. The first thing done was to replace the submarine bells with oscillators. Later a radio beacon was added and the change was complete. Germany now has eleven oscillator stations of which seven are equipped to provide the distance signals.

Of the total of seven submarine signal stations in Denmark, six provide the mariner with distance signals. Sweden has two distance finding stations and several more are in prospect.

England has also started the conversion of her submarine signal stations to the newer form. Five of her twenty-two submarine signal stations are now equipped with oscillators. So far, only one of these oscillator stations is fitted to provide knowledge of distance, but it is confidently expected by shipping people that more of the submarine signal stations will soon be converted to provide knowledge of distance.

That distance finding is well thought of in English marine circles can be seen from the following excerpt from a recent article in the *Nautical Magazine*:

"Captains and officers who have tested the navigating value of these appliances for synchronous signaling are unanimous as to its accuracy and practical utility. Within the next year or two it seems highly probable that all ships will be fitted with appliances for using conjunctively these most modern aids to the safety of navigation in darkness, rain or fog."

Ireland, Canada, Holland, and the United States each have one distance finding station.

It is a significant thing that one of the areas where there is the most marine traffic has been the most active area in installing distance finding stations, even though several separate governments divide control of that region, the English Channel, North Sea and Baltic Sea. Few, indeed, are the hours that can pass while a ship is being navigated through this region without there being an opportunity to verify position by the aid of distance finding.

The United States Shipping Board has installed distance finding apparatus on many of its vessels and has found this new method of position finding to be of great value in navigation, as can be seen from the following statement from its eleventh annual report (for the fiscal year ended June 30, 1927):

"Progress was made during the year in the development of the 'Synchronized radio and submarine signal' method of distance and position finding at sea by utilization of radio and submarine signals sent out simultaneously by lightships. A large number of Merchant Fleet Corporation ships were equipped with apparatus by means of which such synchronized signals are very satisfactorily utilized. Distance and position finding by this method have proved in the several months' use to be entirely practical and reliable."

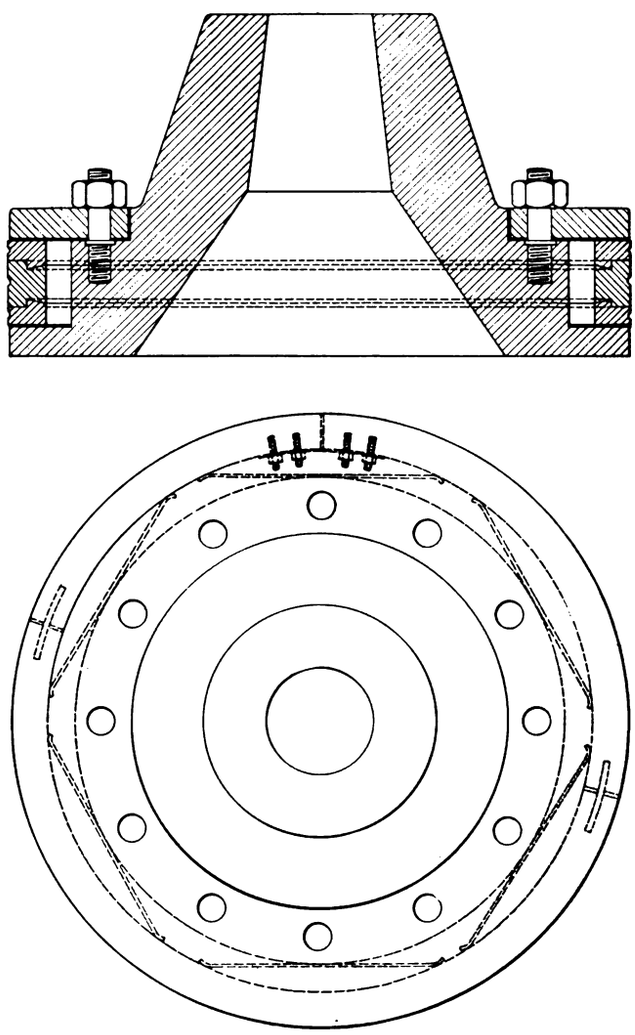
The accuracy of a position found by distance finding or subaqueous sound ranging, as it is technically known, is of a very high order, and, according to the United States Coast and Geodetic Survey, ranks second only to the accuracy of fixes from visual terrestrial objects.

In addition to the security that it provides in navigation, distance finding commends itself to the shipowner in the interest of full utilization of facilities. Most modern ships today have submarine signal apparatus in addition to some form of radio apparatus. When used independently, these systems provide a valuable service, but when used jointly, they provide the most valuable kind of service, knowledge of position.

The rapid strides with which distance finding is advancing in foreign waters constitute a positive indication of the fact that distance finding is well on its way to universal adoption.

Expanding Type Piston Ring

A PISTON ring and piston valve ring, so designed that it can be installed in practically any piston or valve spool without requiring alterations in them, has been patented by C. H. Taylor of Houston, Texas. The feature of the construction of this ring, as shown in the illustration, is that as it wears the expanding springs which force it against the cylinder wall main-



Sectional elevation and plan of high pressure piston equipped with expanding ring

tain it in a tight condition. It is stated that there is no tendency for the ring to drag or score the valve chamber walls when it is installed for piston valve service.

This type ring has been in use on the valves and pistons of oil tanker machinery for about 4 years. During this time the ship in question has steamed about 66,000 miles a year. Some of the rings have been in contin-

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uous service for more than 198,000 miles and are still giving good service. On this ship the rings have been installed on one high pressure cylinder for the entire four years; four 13½-inch valve rings were installed in two medium pressure valves three years ago while 2½ years ago two more of the valve rings were installed in the high pressure piston valves. On June 10, 1926, one set of piston rings was installed in the high pressure cylinder. All of the rings are still in constant use. The high pressure cylinder has a diameter of 25⅜ inches and operates at 200 pounds per square inch steam pressure. This cylinder was not rebored before the rings were installed.

Simple Method of Determining the Stability of Vessels

By F. G. Cooke

THE stability of floating bodies is a subject that has been exhaustively covered by students of naval architecture and the principles and methods of calculation are thoroughly understood. The curve of righting moments of any vessel can be determined with any desired degree of accuracy if the form of the vessel and the position of its center of gravity are known.

In the case of most modern steel vessels, the form is defined by a set of offsets taken from the mold loft floor and usually reproduced on a body plan to a convenient scale. Owners are usually careful to obtain a copy of this plan and preserve it for future reference. The position of the center of gravity is determined, either by an inclining experiment, or by a detailed calculation of the weights and positions of centers of gravity of the component parts of the hull, fittings, machinery, etc. In either case, the accuracy with which the position of the center of gravity is known will depend upon the care with which experiment or calculation is made.

Stability of Earlier Type Ships

In the case of older vessels and also later wooden vessels and small boats, the records of offsets and body plans are oftentimes lost, if indeed such records or plans were ever made. In comparatively few cases are curves of displacement and the usual functions of water planes, etc., prepared. Without these curves, the position of the center of gravity of the vessel cannot be determined by an inclining experiment. To reproduce the lines by measuring offsets directly from the vessel is a laborious task, involving docking or hauling out on a railway and requires the utmost diligence in establishing base lines, squaring up stations, etc.

Of late years the importance of knowing the stability of this latter class of vessels has been better appreciated and the regulations of the Steamboat Inspection Service now require the investigation of the stability of certain vessels, even in the motor boat class, when any question of their safety exists.

The object of this article is to point out a simple method of determining the curve of righting moments directly by experiment, without the necessity of determining the functions usually found on a displacement sheet and therefore without the necessity of docking the vessel or hauling out on a railway. There is nothing novel in the method, but its very simplicity may have caused it to be overlooked as an accurate method of determining stability. It may be considered merely as a "full size" experiment.

Applying the Method

Let us consider a small vessel which has been certified to carry 200 passengers, which has seen service for several years and the safety of which has been for some reason questioned. The vessel may be moored in still water and brought to her usual operating condition, minus the passenger load. Weights equivalent to the passenger allowance may then be put on board, distributed fore and aft to give the usual trim and distributed on the various decks according to the worst probable disposition of passengers, or in accordance with such rules as may be promulgated by the proper authorities. These weights should be balanced transversely and they may consist of any available material, such as package freight, pig iron. iron bars or pipe, bags of cement or sand, etc. The weight should be divided into several parts, the weight of each individual part being known. A pendulum should be swung from a convenient location as usual in inclining experiments and a batten provided for recording deflections. The vessel is now in the condition it would be in when carrying its allowable load of passengers. If now, heeling moments are imposed on the vessel by shifting the individual inclining weights through measured transverse distances and a record of the corresponding inclinations is made, a curve of statical stability for the given condition may be plotted directly, because, as the vessel is in a state of equilibrium under the various imposed heeling moments, the righting moments must be equal to the heeling moments. It must be remembered, however, that if the movements of the inclining weights are measured in a plane parallel to the original water plane of the vessel, the heeling moments must be multiplied by the cosine of the angle of inclination before being plotted. For small angles, however, this correction is negligible. This curve will be the curve of statical stability corresponding to the vessel with the assumed number of passengers on board, although what the displacement actually is cannot be determined nor is it necessary.

Fig. 1 shows such a curve for a hypothetical case. The moment of initial stability may be determined by drawing

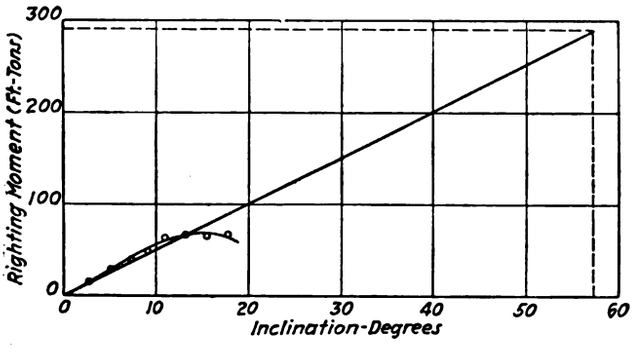

Fig. 1.—Curve of statical stability

a tangent at the origin and noting the righting arm, at 57.3 degrees, of this tangent. If a displacement curve or loading scale is available, the metacentric height may be accurately determined by dividing the moment of initial stability by the displacement. If no such curve or scale is available, the metacentric height may be determined approximately by calculating the displacement from the length, beam and draft, and an assumed coefficient of fineness. The accuracy of this determination will be exactly proportional to the accuracy with which the coefficient of fineness is estimated. It should be noted, however that overestimating the value of this coefficient, will result in too low a value for the metacentric height, and vice versa.

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The inclinations may be carried to any desired angle for which the vessel has positive stability. Caution should be exercised in certain types of vessels with low freeboard where the curve drops off rapidly as shown in Fig. 2. In such cases the curves should be plotted as the inclinations are being made and the experiment stopped before a dangerous angle is reached, unless in the case of a small boat precautions can be taken to prevent capsizing. Usually, however, the curve will show increasing moments until the deck edge goes under and it will seldom be necessary to carry the experiment beyond this point. Similar curves for a fewer number of passengers may of course be drawn by reducing the amount of heeling weight to the corresponding weight of passengers.

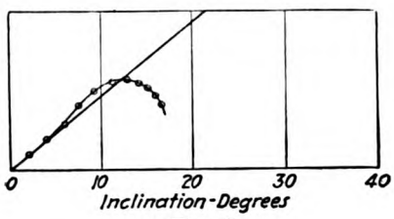
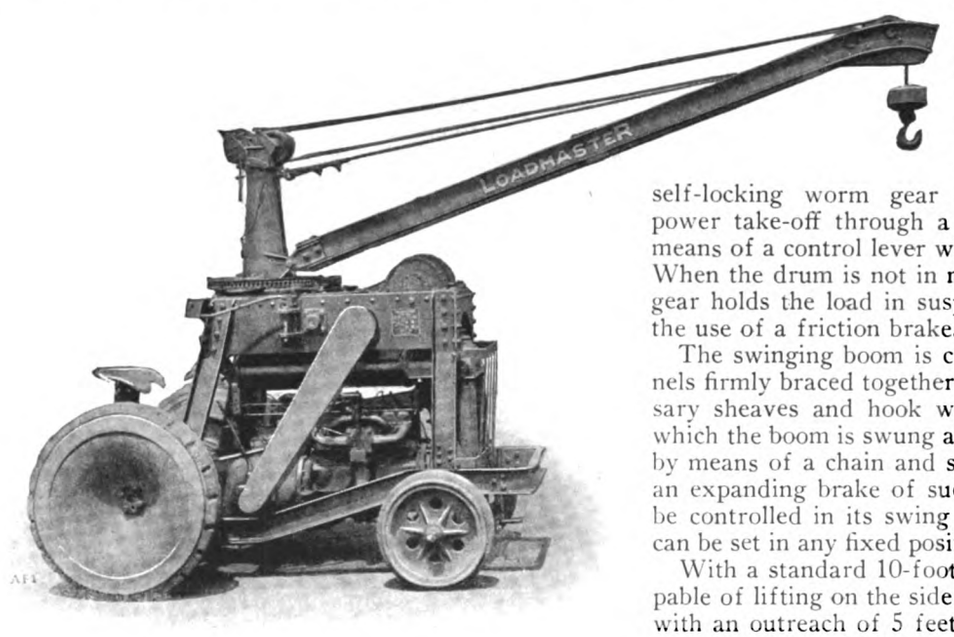


Fig. 2

It may be argued that this method will involve the use of too great weights, and will be unduly expensive. In the case of vessels carrying several hundred passengers this might be true, but even then, in the event that no lines or displacement curves were available, it would probably be both easier and cheaper to assemble a hundred tons of miscellaneous weight (corresponding to about 1,500 passengers) than to haul the vessel out, lift offsets, incline the vessel in the regular way, and calculate displacement curves, cross curves and stability curves. In the case of a small vessel carrying 150 passengers, the assembly of 10 tons of inclining weight would be a comparatively simple matter.



Loadmaster crane mounted on industrial tractor

LEVIATHAN DRY DOCKING.—The Shipping Board has approved necessary expenses for drydocking the *Leviathan* at the Boston Navy Yard during the period July 21 to July 29. This is the regular semi-annual drydocking of the vessel.

General Utility Locomotive Type Swing Crane

A SMALL locomotive type crane for general utility service around industrial plants has been announced by the firm of Frederic H. Poor, Inc., 50 Church street, New York. It is stated that the Loadmaster swing crane, as it is called, is capable of easily handling loads which cannot be advantageously handled by manual labor and where the installation of large and costly crane units are out of the question.

The Loadmaster is mounted upon an industrial tractor and can be moved from place to place under its own motive power. The power for lifting and swinging loads is derived through a power take-off from the tractor engine. In its design, thorough consideration has been given to providing stability and sturdiness in the unit. To this end specially weighted wheels are employed at both rear and front to counterbalance loads in suspension from the boom. At the same time the wheels are equipped with broad tires so that loads are sustained without undue tire loading.

The frame upon which the mast is located consists of a fabricated plate and channel structure secured at the rear to the axle of the tractor. In front, the frame is suspended in such a way as to compensate for irregularities in the floor or roadbed over which the machine travels. The hoisting drum is directly connected to a self-locking worm gear and is operated from the power take-off through a clutch and bevel pinions by means of a control lever within easy reach of the driver. When the drum is not in motion, the self-locking worm gear holds the load in suspension on the boom without the use of a friction brake.

The swinging boom is constructed of two steel channels firmly braced together and equipped with the necessary sheaves and hook weight. The bull wheel by which the boom is swung about the mast is power driven by means of a chain and sprocket and is equipped with an expanding brake of such design that the boom may be controlled in its swing or when not under power it can be set in any fixed position.

With a standard 10-foot boom, the Loadmaster is capable of lifting on the side swing a load of 1,800 pounds with an outreach of 5 feet 6 inches; 1,250 pounds with an outreach of 8 feet and 1,000 pounds at the maximum outreach of 10 feet. The lifting capacity is greatest with the boom directly forward; in this case it is capable of lifting 3,000 pounds with an outreach of 5 feet 6 inches; 3,000 pounds with an outreach of 8 feet and 2,400 pounds with an outreach of 10 feet. The full swing arc of the boom under load is approximately 240 degrees; that is, 120 degrees either side of the forward position. Adjustable telescoping outriggers, allowing heavier loads to be swung over the sides, are available at a slightly additional cost.

PILE DRIVER BARGE—A pile driver barge, 58 feet long by 26 feet beam by 6 feet depth, built under the Ellis channel system of steel hull construction for the New York Central lines, has recently been completed at the Atlantic Works, Boston.

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Questions and Answers for Engineers

Practical information on the operation and maintenance of boilers, engines and auxiliaries

This department is maintained to help those who desire practical information regarding engine room problems or who are preparing to take examinations for a marine engineer's license. Readers are urged to send in questions. Inquiries bearing the name and address of the writer will be answered promptly by mail. If the question is of general interest the answer will also be published in an early issue of the magazine, although the identity of the writer will not be disclosed in doing so. Anonymous communications will not be considered.

Size of Boiler Tubes

Q.—How are the sizes of boiler tubes designated?

A.—Sizes of boiler tubes are designated by the outside diameter to distinguish them from pipes, which are measured by their inside diameter. Tubes of more than 6 inches in diameter are generally called flues.

Solid Injection

Q.—What is meant by the term solid injection?

A.—Solid injection means that the valve is completely filled with fuel oil, and when the fuel injection valve opens the fuel is forced into the cylinders under great pressure by pumps, which is called mechanical injection.

Advantages of Fuel Oil

Q.—What are some of the advantages in using fuel oil?

A.—High evaporative power per unit weight, ease of manipulation, perfect control of combustion to suit different requirements of service, cleanliness and minimum number of men in fireroom crew.

Combustion Chambers

Q.—What is the purpose of the combustion chamber?

A.—The purpose of a combustion chamber is to provide a place for the unconsumed gases to be thoroughly mixed with air, which promotes their complete combustion.

Care of Boiler Brick Work

Q.—What attention should be given to the boiler brickwork?

A.—Make sure at every opportunity that the furnace, combustion chamber and smoke flue are tight as the admission of air through the brick work of the setting is a source of considerable loss.

Failure of Diesel Engine to Ignite

Q.—What are some of the reasons of failure to ignite?

A.—Failure of the engine to start firing may be traced to one or more of the following troubles: Insufficient or no fuel; low compression pressure in the engine cylinder; too low an injection air pressure; or cold cylinders. If the engine fails to fire at the first trial, the engineer should not waste the compressed air in the repeated trials, but should investigate and make the necessary correction.

Can a Crank Pin Be Trued in Place?

Q.—Is there any machine on the market that will true Diesel engine crank pins while they are in place in the engine?

A.—Inquiry among a number of machine tool authorities reveals the fact that it is very doubtful if a tool is being manufactured in this country capable of re-truing a crank pin of a steam reciprocating or Diesel engine without removal of the shaft from its bearings.

High Furnace Temperature Aids Combustion

Q.—Is a high furnace temperature conducive to good combustion and what is a very efficient agency for maintaining a high furnace temperature?

A.—Yes, because the hydrocarbons unite with the oxygen much more quickly, and the fixed carbon also is much more completely united with oxygen in a high temperature. Firebrick arches and baffles for the gases to impinge against are considered very efficient agencies.

Piston Speed of Pump

Q.—What is meant by the term piston speed of a pump?

A.—Piston speed of a pump is the number of feet traveled per minute by the plunger when discharging water or other liquids. The piston speed equals the length of the stroke in feet multiplied by the number of working strokes per minute. In a double acting pump, the number of strokes is the same as the total number of plunger strokes of one plunger, both forward and backward; in a single acting pump, it is half that number.

A Propulsion Problem

Q.—Assuming a tug with a compound condensing engine 14 inches by 28 inches by 20 inches stroke, 350 indicated horsepower; steam pressure, 150 pounds; revolutions, 150; with a cast steel propeller 7 feet 2 inches diameter (pitch unknown) making 10 knots, owing to reduction in steam pressure (135 pounds) and a corresponding reduction in revolutions of engine (130) the boat is now making 9 knots. Is there any way I can get back to the original speed of 10 knots by making changes in the size and pitch of propeller? If so, how? The length of the boat is 70 feet (85 feet overall); breadth, 19.4 feet; draft, 10 feet.

A.—There is no way of returning to your former speed of 10 knots without returning to your original boiler pressure. There is, however, a possibility of regaining a part of this lost speed by readjustment of valve cut-offs and the design of a more efficient propeller. In order to make a comprehensive study of the propeller problem it would be necessary to ascertain its present pitch and projected area ratio, displacement and trial data, as now operated, over the measured mile, effective horsepower points at the higher speeds, lines of the boat's underbody, etc.

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Cooling a Hot Compressor

Q.—If you had a hot compressor, due to over-lubrication, how would you remedy it?

A.—I would stop the compressor, open up and clean the passages. I would use paraffin oil and then make sure that all traces were removed before closing the compressor up. I would then turn it over a few times by hand with the high pressure discharge pipe disconnected, and, if possible, run slowly for a few minutes before connecting the discharge pipe.

Effect of Breaking of Propeller Shaft Connected to Shunt-Wound Motor

Q.—What would happen if the propeller shaft on a shunt-wound motor with fixed excitation should break? The motor is connected in series with two generators, the speed of the motor being controlled by varying the excitation on the generators.

A.—The breaking of the propeller shaft connected to a shunt-wound motor could in no way cause damage as the loss of load would affect its speed of revolution but slightly. This is one of the chief advantages in this type of motor.

How to Fit Check Valves

Q.—What is the proper way of fitting check valves to a watertube boiler? Should one valve seat be against the boiler pressure and the other against the feed water pressure or should both valve seats be against the feed water pressure?

A.—At the boiler there should be a feed check and stop valve both fitted with handwheels, the check valve having an extension handle or gear for working from the fire room floor. The valve bodies should be so designed that the bottom of the check valve outlet nozzle will be at least 1½ inches above the valve seat. The check valve should be fitted with a spiral spring to assist in its closing with (water on top of valve disk) the incoming feed. It is better that the check valve disk be on top.

These two valves should be in the same casing with the stop valve nearest the boiler, opening against the boiler pressure (steam on top of valve disk) and so constructed that the stuffing box may be packed while pressure is on the boiler.

Procedure in Starting a Diesel Engine

Q.—In starting up a Diesel engine what is the general procedure?

A.—The exact procedure for starting differs with the several makes or types of engines. The general plan for starting up is as follows:

(1) The engineer should be on duty 20 minutes before starting time, to make all necessary preparations.

(2) Open and adjust all lubricators and see that the main bearings and gears have sufficient oil.

(3) Open the valve on the fuel oil line, turn the fuel pump lever on *filling*, after making sure that the test cocks on the cylinder heads are open. As soon as the fuel runs a steady stream *without air bubbles*, put the fuel pump lever in running position.

(4) Bar the engine over one complete turn immediately before starting and then set one of the starting cranks about 15 degrees past top center, after which the barring gear should be thrown out of gear and locked.

(5) After making sure that the pumps are working properly, the testing cocks should then be closed and five to ten strokes pumped into the spray valves, in case the pumps have hand plungers. If the fuel pumps have been dismantled, an easy way to ascertain if the pump is all right is to put blast air in line; by pumping with the hand pump, resistance should be felt which will vary according to the air pressure in the blast line. If no resistance is felt, this would show that the pump is not in working order and it would be useless to attempt starting the engine as the fuel pump must be capable of pumping oil against a pressure as high as 1,100 pounds per square inch when the engine is in service.

(6) Turn on the cooling water and never start before the water runs freely.

(7) Open the air compressor throttle and see that the drains on the coolers are closed.

(8) Ascertain the air pressure in the air bottles; never start with less than 700 pounds pressure. Open the compressor and blast valves on a blast bottle, then open the main valve on one of the starting bottles, which will set the engine in motion.

(9) If the starting and injection pressure is low, prevent a false start by taking the following precautions: Prime the fuel delivery pipes (noting the specific instructions regarding the fuel pump). With a bar under the valve levers try all the valves to see that none of them sticks. Fill the water jackets with warm water. Remove all possible load from the engine. If the injection air pressure is also insufficient (below 525 pounds per square inch), the valve of the injection air bottle should not be opened. The air pump will furnish the required injection air pressure after a few revolutions. When the engine comes up to speed, open the valve in the injection air bottle gradually to raise the pressure up to normal. If the engine drives a generator, this can be used as a motor for starting, in the following manner: Hook down the exhaust levers, do not open the injection air receiver, place the controlling wheel of the fuel pump at "Stop." When the engine comes up to speed, release the exhaust valve levers and set the fuel pump control wheel to "Work," prime with kerosene, if used for fuel. Never use oxygen for starting.

(10) After the engine has made four or five revolutions, put the starting levers on each cylinder to the running position, which puts the starting cams out and the fuel cams in action; then close the valve on the starting bottle; as soon as engine is under full speed and the cylinders fire regularly, the load may be put on.

Donkey Boiler Fittings

Q.—Name all fittings on a donkey boiler. What are the Steamboat Inspection Service requirements for same?

A.—The following is a list of fittings required for a donkey boiler:

Main steam stop valve.
Safety valve.
Water gage.
Try cocks.
Main feed stop valves.
Main feed check valve.
Auxiliary feed stop valve.
Auxiliary feed check valve.
Surface flow valve.
Bottom blow valve.
Plug drain cock.
Steam gage.
Salinometer connection.
Circulator.

The Steamboat Inspection Service requirements covering the above boiler mountings would take up more space than these columns permit. It is suggested that you write the Department of Commerce, Steamboat Inspection Service, for a copy of the "General Rules and Regulations Prescribed by the Board of Supervising Inspectors".

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Questions and Answers Relating to Ship Design and Construction

By J. L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Application of Usual Formulas for Torsional Stress to Non-Circular Beams and Shafts

Q.—Will you please discuss the propriety of applying the usual formulas for angle of twist and torsional stress to non-circular beams and shafts? Are the polar moment of inertia and the polar section modulus proper criterions of the twist and stress for differently shaped sections under the same torque?

A.—The Navier, or common, theory of torsion assumes that any normal cross section of a beam or shaft remains plane during torsion; also, that the strain, and consequently the stress, at any point in the section is directly proportional to the distance from the neutral line of the beam or shaft; this line being defined as the locus of points for which the strain is zero.

Although some of the formulas developed on these assumptions were in direct contradiction to certain well known facts, they were generally used by engineers of the last century and are still in use where no great accuracy is required. This may be readily explained by the fact that the greatest use made of these formulas was in cases of circular shafts for which they are correct. When we attempt to generalize by applying them to any cross section, they lead to entirely erroneous results.

According to the common theory of torsion, the greatest stress would occur at the extremities of the major axis of an elliptical section and at the corners of a rectangular section, whereas experiments prove just the opposite. The maximum stresses occur at the extremities of the minor axis of an elliptical section and at the mid-point of the longer side of a rectangular section.

The error of the assumption that the normal section remains plane under torsion, instead of being warped, may be readily verified by twisting a non-circular bar of india-rubber with the hands. It is also a well known fact that the stresses do not vary directly with the distance from the neutral axis of the section.

The modern theory of torsion, which dates from 1864, was founded by Saint Venant, who completely revised the fundamental assumptions of Navier.

Without attempting any mathematical analysis of the assumptions involved in the two theories, there is tabulated below a comparison of the formulas for the torsion angle and the maximum stress in various solid cross sections as given by both the common theory and that of Saint Venant as given by Professor Burr in his treatise "The Elasticity and Resistance of the Materials of Engineering." Unfortunately, only a few sections whose boundary equations assume certain forms admit of exact solutions. The general case is, perhaps, unsolvable, and even for rectangles the results here given are only close approximations.

Section	By Common Theory	By Modern Theory	Difference Between Modern Over Common Theory
Ellipse; major axis=2a, minor axis=2b	$\alpha = \frac{4\,ML}{\pi ab(a^2+b^2)G}$ $S = \frac{4\,M}{\pi b(a^2+b^2)}$	$\alpha = \frac{ML(a^2+b^2)}{\pi a^3b^3G}$ $S = \frac{2\,M}{\pi ab^2}$	Varies with ratio of a to b
Equilateral triangle side=a	$\alpha = \frac{27.71\,ML}{a^4G}$ $S = \frac{16\,M}{a^3}$	$\alpha = \frac{46.19\,ML}{a^4G}$ $S = \frac{20\,M}{a^3}$	67 percent greater 25 per cent greater
Square, side=a	$\alpha = \frac{6\,ML}{a^4G}$ $S = \frac{4.24\,M}{a^3}$	$\alpha = \frac{7.11\,ML}{a^4G}$ $S = \frac{4.81\,M}{a^3}$	18.5 percent greater 13.4 percent greater
Rectangle; short side=a, long side=3/2a	$\alpha = \frac{2.46\,ML}{a^4G}$ $S = \frac{2.22\,M}{a^3}$	$\alpha = \frac{3.41\,ML}{a^4G}$ $S = \frac{2.89\,M}{a^3}$	38.6 percent greater 30.2 percent greater
Rectangle; short side=a, long side=2a	$\alpha = \frac{1.2\,ML}{a^4G}$ $S = \frac{1.34\,M}{a^3}$	$\alpha = \frac{2.19\,ML}{a^4G}$ $S = \frac{2.03\,M}{a^3}$	82.5 percent greater 51.5 percent greater
Rectangle; short side=a, long side=3a	$\alpha = \frac{.4\,ML}{a^4G}$ $S = \frac{.63\,M}{a^3}$	$\alpha = \frac{1.27\,ML}{a^4G}$ $S = \frac{1.26\,M}{a^3}$	217.5 percent greater 100 percent greater
Rectangle; short side=a, long side=4a	$\alpha = \frac{.18\,ML}{a^4G}$ $S = \frac{.36\,M}{a^3}$	$\alpha = \frac{.89\,ML}{a^4G}$ $S = \frac{.89\,M}{a^3}$	394.4 percent greater 147.2 percent greater

In the above tabulation,

α = The maximum torsion angle, in radians.
L = Length of beam or shaft, in inches.
M = Moment of torsion (torque), in inch-pounds.
S = Maximum shearing stress, in pounds per square inch.
G = Shearing modulus of elasticity.

It will be observed that the formulas based on the modern theory give much larger values for both the angle of torsion and the maximum shearing stress than do those in common use. The difference is particularly noticeable in the rectangular section where the variation increases rapidly with the increase in the ratio of the long to the short side.

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Communication

Measuring Shaft Horsepower

WASHINGTON, D. C.

TO THE EDITOR:

In the September 1927 issue the question was asked: "What is the power available at the shaft called and how is it measured?" The answer was: "Shaft horsepower or brake horsepower. It is usually measured by attaching some form of brake to the shaft and measuring the amount of power absorbed by the brake when the engine is running. A second method is to attach an electric generator to the shaft and measure the electrical output of the generator."

The writer disagrees with the answer to the second part of the question. Such a method of measuring shaft or brake horsepower would absorb all the power developed, and such a brake or generator instrument for measuring power is suitable only for testing power plants on the testing stand or in the shop or under such conditions as will permit the power developed being used up in the power testing instrument. Power testing instruments of this type are known as absorption dynamometers.

On shipboard it is necessary to test the shaft or brake horsepower while the propellers are revolving, almost always with the ship underway. Naturally the propellers are absorbing the power developed and consequently it is necessary to use a power testing instrument which does not absorb any power or at the most an extremely small amount necessary to move the instrument. Power testing instruments of this type are known as transmission dynamometers.

There are several types of transmission dynamometers but the type universally used on shipboard is known as a torsion meter. Such an instrument measures the twist in a given length of shaft. This is generally recorded on a card but in some instruments may be observed optically. Inasmuch as this angular twist is proportional to the twisting moment on the shaft, we may compute the shaft horsepower by the formula

$$\text{S.H.P.} = \frac{2\pi \times T \times N}{12 \times 33{,}000}$$

where T = twisting moment in inch-pounds.
N = revolutions in one minute.

This formula in actual practice reduces to

S.H.P. = K x T x RPM —

where K is a constant for the shaft determined by calibration.

T is the linear distance between the marks on the torsion meter card.

N = revolutions in one minute.

The following material is taken from Moyer's "Power Plant Testing" published by the McGraw-Hill Book Company of New York.

Torsion meters, although applicable to large as well as small powers, have their most important applications for measuring shaft horsepower of marine turbines and engines.

A shaft dynamometer consists essentially of a long metal tube encircling the shaft or within the shaft if it is a hollow one and fastened to it at one end, but free at the other and is maintained in alinement by adjustable rollers; two radial arms, one attached to the shaft and the other to the free end of the tube, which rotate a slight amount with reference to each other, according to the twist of the enclosed length of shaft; and a set of levers which multiply this rotative movement and at the same time convert it into linear motion, which is transmitted to a sleeve and collar mounted upon the shaft and sliding thereon. These parts all revolve with the shaft. An independent indicating apparatus is provided, which is mounted on a stationary frame, and the sliding movements of the rotating collar is transmitted through it to an index hand. The torsional strain is determined from the reading of the accompanying scale, which is graduated to millimeters.

The zero reading is found by disconnecting the propeller and turning the shaft at a slow speed, first in one direction and then in the other, observing the indication in both cases, and fixing the point of zero strain at the mean of the two. When it is impracticable to disconnect the propeller the readings may be taken when the vessel is drifting under her own headway after shutting off steam. The calibration of the instrument, which can best be done when the shaft is in the shop before installation, is carried on by securing the shaft in a fixed position, and applying a torsional strain by means of weights at the end of a lever attached beyond the dynamometer, taking readings with a number of different weights.

The horsepower shown by the dynamometer is determined by multiplying the reading of the instrument expressed in millimeters by the number of revolutions of the shaft per minute, and by a constant determined from the calibration. The constant is an expression for the horsepower corresponding to a speed of one revolution per minute and a reading of one millimeter.

A shaft dynamometer requires very delicate adjustment as such instruments used on large steam turbines and engines requiring a shaft of comparatively large size, require a movement at the end of the two arms of only one hundredth of an inch to produce a change of 500 horsepower in the load being transmitted.

Co-operation Between Deck and Engineer Officers

NORFOLK, VA.

TO THE EDITOR:

Some time ago the master of one of our large passenger liners, in reporting a delay of six hours to his owners, stated that it was caused by "some pump giving out." He didn't know what pump, or its use, or why it was of such importance that, without it, his steamer was brought to a standstill, until the engineers had effected a repair to enable the vessel to continue her voyage. All he knew was that a pump had broken down and all the other facts and information would be furnished in due course by the chief engineer and his log book.

It seems to me that this lack of knowledge, on the part of the deck officers, of anything outside their own department is criminal, and I am glad to note that this deficiency is not as prevalent nowadays as it was a few years back. However, there is much scope for improvement, and there should be more cooperation between the deck and engine room officers. They should take more interest in the duties of each other in the operation of their ship.

It is to be regretted that some engineers do not get along as well with their brethern of the deck as they might, and that they should have the idea that instructing a "deck swab" into the mysteries of their profession would be little short of treason to their cloth. Such ideas are old-fashioned and foolish, besides being detrimental to the service they both follow. By retaining such notions they are not giving their employers a square deal.

During my sea service in the merchant marine, and subsequently in the navy, reciprocity in the instruction of deck and engineer officers was demanded. Eventually all deck officers knew how to manipulate the engines.

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and knew the name and function of every piece of machinery on board. They received theoretical and sometimes practical training on how to repair a breakdown, and the procedure to be followed in compounding an engine, changing over the exhaust from the condenser to the atmosphere, etc. In turn the engineers could find the ship's position, take and work out a sight and box the compass. In one instance, one engineer became an expert in adjusting and compensating compasses and is following this profession at the present time. As to myself, the instruction I received from my deck colleagues was such that I could navigate a ship to any port in the world as well as they could themselves.

GEORGE R. FREEMAN,
Consulting Engineer.

Bad Feed Water in High Pressure Express Boilers

ANNAPOLIS, MD.

TO THE EDITOR:

The recent account of the giving away of fire row tubes in the high pressure Yarrow boiler of the British steamer *King George V*, the troubles with boiler tubes on the high pressure (1,200 pounds per square inch) boilers of Lakeside Station, Milwaukee, and other recent cases of failures of fire row tubes on express boilers, appear to show a rather startling inability on the part of the operating forces to apply proper methods of feed water conditioning, well known to feed water chemists and extensively published in engineering literature. It is well known that lime which was used in the boilers of the *King Gorg V* is not a satisfactory feed water treatment for high pressure and high capacity, although it is of some use for low pressures and low capacity and will do for Scotch boilers.

It is also well known that any hard water or contaminated water will produce dangerous scale in an express boiler in a very short time unless proper reagents are added to condition the feed water. Yet here we have the situation of special boiler installations, supposed to be the last word in progressive engineering and attracting the widest possible interest of the engineering public, being allowed to get into a dangerous and unsafe condition by failure to take certain more or less generally known elementary and simple precautions.

Instructions for Boiler Operation

The United States Navy instructions for operating boilers give suitable directions for avoiding the trouble encountered. The A. S. M. E. Boiler Code does also. Numerous engineering handbooks and innumerable pamphlets issued by reliable specialists in feed water treatment and manufacturers of feed water conditioning materials contain sound advice; yet, with all these things pointing the way, we find some of the latest boiler plants both ashore and afloat allowing their boilers to become filled with scale, from contaminated shore water (sometimes due to condenser leakage), and the feeding of hard make-up water without proper conditioning and control.

The means for avoiding trouble are comparatively simple. All that is necessary is to see that only clean water is used for make-up, and that, if a limited amount of hard or soft water is fed, the necessary feed conditioning chemicals are supplied, so that alkalinity is kept between certain limits; that acidity is always avoided, and that salinity is kept down to a reasonable point. This, of course, requires systematic and routine testing of the boiler water, which is a comparatively simple procedure, requiring only limited and inexpensive apparatus.

High pressure and express boilers require suitable feed water and it is not a very difficult thing to provide it. The operating personnel, however, must see that the necessary things are done. A low pressure tank boiler will work with comparatively bad water but a high pressure or small tube express boiler will not. In these days, with the special information available in regard to feed water treatment and conditioning, there is no real excuse for destructive scale in boilers.

CAPTAIN H. C. DINGER, U. S. N.

Speed Versus Power of Engine

BROOKLYN, N. Y.

TO THE EDITOR:

The Questions and Answers department in MARINE ENGINEERING AND SHIPPING AGE particularly interests me and I learn something from reading its contents month by month that helps to increase my general store of knowledge. This is not a preface to an intended criticism or a "bit of fault finding" in relation to the Questions and Answers, but you may consider it a reason for my making the following request: It is in connection with the Question and Answer concerning "Speed versus Power of Engine," page 339 in the June issue. If I may, I would like to add something to the present answer. The answer is brief, to the point, and correct. I appreciate the necessity for brevity, and frequently practice it myself in answering questions.

There is a possibility that the person who asked the question in the first place may have had in mind the well known formula for the indicated horsepower of engines, i.e.,

$$\frac{PLAN}{33{,}000} = \text{horsepower},$$

and may wonder how the formula and the answer to the question can be reconciled. As I said before, the answer is correct. Doubling the revolutions per minute does not necessarily mean that the power developed by the engine will also be doubled, for the reasons given in the answer. The formula also is mathematically, or arithmetrically correct; but at first blush it does not seen to "jibe" with the answer. However, each agrees with the other, as can be learned if one gives a little thought to the subject as a whole.

Referring to the formula in its application to any given engine, there are only two factors that may be "variables," namely, the P and N. Increasing either or both of these factors means an increase in the horsepower result. So it would seem that by doubling the value of N (the number of piston strokes per minute, which also represents the number of revolutions per minute as stated in the question) the quotient, horsepower, will also be doubled, and so it would, provided the value of the other variable P did not change; but it does change in spite of the fact that the *boiler pressure* and the *point of cut-off may not have changed*, because P represents the *mean effective pressure*, which will be decreased by the increased back pressure mentioned in the answer to the question. In order to double the power of the engine by doubling the number of revolutions, the mean effective pressure (P) must be maintained either by increasing the boiler pressure to

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a certain figure, or by increasing the point of cut-off from the beginning of the stroke, or both.

The foregoing may be of interest to some of the younger members of the craft.

CHARLES J. MASON.

New Books

THE PORT OF HAMBURG. By Dr. Ing. L. Wendemuth and Dipl. Ing. W. Böttcher. Size, 8¼ by 6¾ inches. Pages, 231. Illustrations, 87. Hamburg, 1927: Meissner & Christiansen.

This book, which describes Hamburg, the most easterly link in the chain of North Sea ports, discusses the foundation and development of the port, giving general details of the harbor plan, mechanical equipment and terminal facilities, organization of harbor services and floating harbor equipment. In addition, a portion of the book is devoted to the Elbe River, which connects Hamburg with the sea, as well as the Port of Cuxhaven, which offers service supplementary to that of the Port of Hamburg.

THE CAUSES OF FAILURE OF WROUGHT IRON CHAINS. By H. J. Gough, M. B. E., D. Sc., Ph. D., and A. J. Murphy, M. Sc. Size, 9¾ by 6 inches. Pages, 167. Illustrations, 51. Numerous charts and tables. London, 1928: Published under the authority of His Majesty's Stationery Office. Available in the United States at the British Library of information, 44 Whitehall street, New York. Price, 7s 6d.

Due to the meager information available on the strength of wrought iron chain under service conditions, an investigation of the subject was instituted by the Department of Scientific and Industrial Research in 1924. The results of this investigation, which was carried out at the National Physical Laboratory, form the subject matter of the present report. The first part of the investigation covers the practice of low temperature annealing and its effect in producing brittleness in wrought iron chain. For this purpose static tensile and impact tensile tests were employed. The second part of the investigation relates to the properties of chains drawn from service records. Two classes of chain were studied; first, chains which were periodically proved and annealed throughout their useful life; and second, chains which were periodically proved only, without annealing. The investigation was exhaustively prosecuted over a period of years and the results form an authoritative guide on the manufacture and maintenance of chains in service.

Personal

William H. Todd has been re-elected president, **Arthur E. Goddard** vice-president, **Sanford S. Cox** secretary and treasurer and **E. P. Enfer** assistant secretary and treasurer of the **Todd Shipyards Corporation,** New York, at a recent meeting of the stockholders.

William Groundwater, manager of transportation, **Union Oil Company of California,** has been appointed to serve on the American Committee of Classification, **Lloyd's Register of Shipping.**

H. T. Keene, first assistant engineer of the Matson liner **Malolo,** has been promoted to chief engineer of the S. S. **Matsonia.**

Edward J. Mooney, chief engineer of the **Matsonia** for several years, has succeeded **Henry Wolters** to the post of assistant port engineer. He joined the Matson service on September 21, 1921, as chief engineer of the steamship **Lurline.**

Robert L. Hague, president of the **Standard Shipping Company,** N. Y., and **Henry Herbermann,** president of the **Export Steamship Corporation,** New York, were admitted to membership in the **American Bureau of Shipping** at the spring meeting held May 30 at 24 Old Slip, New York.

Henry J. Wolters has been appointed port engineer of the **Matson Navigation Company,** San Francisco, Cal., assuming the position left vacant by the retirement of **Joseph Barker.** Mr. Wolters was assistant port engineer under Mr. Barker and has been in the Matson Line service since July 25, 1918.

J. G. Starr, secretary of the **Board of Harbor Commissioners,** San Pedro, Calif., has been appointed traffic manager of the San Pedro port, succeeding **Captain Samuel S. Sandberg,** recently made a member of the **United States Shipping Board. Michael G. Rouse,** chief rate clerk of the **Atchison, Topeka & Santa Fe Railway Company,** has succeeded Mr. Starr.

John P. Magill has been appointed special representative of the **Maritime Association of the Port of New York.** Mr. Magill will be charged with the duty of representing the association at hearings before legislative bodies, government bureaus and departments and at conventions, conferences and general meetings dealing with subjects affecting the interests of the port.

Cecil N. Bean, formerly chairman of the board of governors of the New Orleans branch of the **Propeller Club of America,** was elected president of that body at the annual meeting of the branch on June 14. Mr. Bean succeeds **A. K. Miller** who has left the club since going into the truck business. The other officers were elected as follows: **W. E. Winship,** vice-president, **C. A. Palmer,** treasurer, and **H. R. Iley,** secretary. The board of directors chosen were **Frank E. Ames, Warren Johnson, J. M. Rault, W. M. Rose, Neal M. Leach, W. J. Hardin, S. E. Paul** and **Roland Linfield.**

Edward E. Taylor, former general manager of the **Goodrich Transit Company,** Chicago, Ill., has recently been elevated to the position of president of that concern. Mr. Taylor entered the service of the Goodrich Company when 18 as a cabin watch. He became the youngest captain in his day on the lakes and served as commodore of the Goodrich fleet for 15 years. In 1921 he became superintendent of the **Graham and Morton Lines,** but in 1924 when these lines were absorbed by the Goodrich Company he became general manager of the latter, filling that post until he was promoted to president. **Major Perry F. Heath,** of Grand Rapids, has been made assistant to the president. Other officers include: **William Alden Smith,** Grand Rapids, Mich., chairman of the board; **Charles C. West,** Manitowoc, Wis., vice-president; **J. Stanley Morton,** Benton

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Harbor, vice-president; and **W. J. Thorp,** Chicago, secretary-treasurer.

John Olsen has been appointed port engineer of the **Cosmopolitan Shipping Company, Inc.,** operating the **American France Line,** filling the vacancy left by **F. C. Williams,** who resigned in May, 1928. Mr. Olsen served his apprenticeship at **Wm. Cramp & Sons Ship & Engine Building Company** Philadelphia, Pa., from 1900 to 1904 and remained with that concern until 1907 when he became a machinist on the Panama Canal at Balboa and Cristobal Dry Dock. In 1909 he became assistant foreman at Cramps and in 1912 he became a marine engineer with the **Panama Railroad Company,** being promoted to chief engineer. In 1922 he was appointed inspector of repairs for the United States Line, which position he held until 1925 when he became supervisor at **W. & A. Fletcher Company,** Hoboken, N. J. He was appointed assistant superintending engineer for the **Cosmopolitan Shipping Company** in 1927.

John Olsen

J. F. Paige, operating manager of the **Black Diamond Steamship Corporation,** has resigned from that organization to enter other fields of a similar nature. Mr. Paige received his technical education at the Truro Mechanics Institute, Truro, Nova Scotia. He entered his career with the **Truro Foundry & Machine Company** and the **Brown & Sharpe Company** after which he spent time with the **Perth Amboy Shipbuilding Company,** Perth Amboy, N. J., and the **Charles L. Seabury & Company,** New York. Five years were spent at sea in which he obtained his chief engineer's unlimited certificate. In 1903 he entered the employ of the **Fore River Shipbuilding Company** and in 1917 he was appointed general manager of the **Port Arthur Shipbuilding Company,** Port Arthur, Canada. In 1924, he became manager of the operating department of the **United States Shipping Board Emergency Fleet Corporation** in the Gulf district, being appointed assistant to the vice-president in charge of operations in 1925. Mr. Paige is a member of the Society of Naval Architects and Marine Engineers and of the American Society of Mechanical Engineers.

J. F. Paige

Obituary

Captain Arthur V. Hulme, New Orleans inspector of hulls for the **United States Steamboat Inspection Service,** died recently at his home in New Orleans, La.

Harry Colwell, chief engineer, S. S. *Western World* of the **Munson Steamship Line,** New York, died suddenly on June 6 at Santos, Brazil, from heat exhaustion, aged 27 years.

James Frederic Tams, chairman of the board of directors of the firm of Tams & King, Inc., New York, naval architects, died recently at his summer home in **Tuxedo Park, New York,** at the age of 81. Mr. Tams was born in Philadelphia, April 13, 1847, and was educated in New York private schools. He entered business with the firm of **Aymar & Company** and later became the first vice-president and treasurer of the American Shipbuilding Company. For nearly 30 years Mr. Tams has been known as a designer of fast racing yachts, and the firm **Tams, Lemoine & Crane,** which later became **Tams & King,** built racing hulls which have rivaled those of the Herreshoff yards for supremacy in American yachting competition.

Harvey Danforth Goulder, organizer and former counsel of the **Lake Carriers Association,** Cleveland, O., died June 14 in Cleveland. Mr. Goulder was born at Cleveland on March 7, 1853, and was admitted to the bar in 1875. He was prominent in maritime, insurance and corporation law and was active in connection with legislation for improvement of channels on the Great Lakes and their tributaries and for rehabilitating the American merchant marine.

Harvey D. Goulder

Alfred G. Smith, president of the **American Shipbuilding Company,** Cleveland, O., died recently in Cleveland. His life-long services in marine matters have made him one of the best known men on the Great Lakes. He began his career in the old **Globe Iron Works,** as a helper when he was 12 years of age. Hard work won rapid promotion and when the American Ship Building Company was formed in 1898 he was made assistant superintendent of the Lorain branch. A few years later he became general manager of the Buffalo yards and later was in charge of the **South Chicago Shipbuilding Company,** a subsidiary. In 1907 he left the company to form the firm of **Smith and Nevins,** naval architects, which subsequently developed into **Smith Brothers.** The firm is now conducted by his two brothers, John and Allen. In 1914 Mr. Smith became general manager of the American Ship Building Company and in 1924 he was made president.

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Ship Construction and Repair News

Proposed work—Bids asked—Bids received—Contracts awarded—Current activities

Midland Barge Co. to Build Forty Steel Pontoons

THE United States Engineer Office, Federal building, 16th street and 2nd avenue, Rock Island, Ill., has awarded a contract to the Midland Barge Company, Midland, Pa., for the construction of forty steel discharge pontoons, at a price of $59,600. Bids for the work were received at Rock Island last month. The pontoons are to be 38 feet by 14 feet by 3 feet.

Norfolk Ferryboat Contract to be Awarded July 1

INFORMATION has been received at this office that the date for the award of contract for one new steel Diesel-electric ferryboat for the Norfolk County Ferries, Portsmouth, Va., has been postponed until July 1. Tenders for the work were received and opened on April 25, at which time the Spear Engineers, Inc., Norfolk, Va., was low bidder with a price of $234,000.

The new vessel will have a length overall 173 feet; length between perpendiculars 146 feet; beam overall 57 feet; beam of hull at deck 37 feet; depth, molded, 14 feet; draft 8 feet 6 inches. The propelling machinery will consist of 2 Bessemer engines of 400 brake-horsepower each, direct connected to two General Electric generators of 270 kilowatts each and one General Electric double armature propelling motor of 650 horsepower on through shafting with propeller at each end. Plans and specifications for the vessel were prepared by Eads Johnson, 115 Broadway, N. Y.

Two West Coast Lines Plan New Tonnage

ACCORDING to an official announcement from the Admiral Line, Seattle, Wash., of which H. F. Alexander is president, this company will in the near future take advantage of the construction loan provisions of the Jones-White bill by building three or four new combination passenger and freight ships. The plans for these vessels have not as yet been definitely formulated, but it is expected that action will be taken in the near future. The line operates services along the West Coast from Los Angeles, San Diego, San Francisco to northern ports as far as Alaska.

Another West Coast line, which is contemplating the construction of new tonnage, is the Hammond Lumber Company of San Francisco, Calif. A. B. Hammond, president of this company, has indicated that with the signing of the bill and because of the satisfactory conditions, it is very probable that the company will build ships within a short time.

Diesel Conversion Plans to Be Issued July 1

INFORMATION has been received that the date for issuing plans and specifications for the conversion of eight Shipping Board vessels to Diesel-electric drive has been postponed until to about July 1, 1928. These plans will be issued by Captain R. D. Gatewood, manager of the maintenance and repair division of the board, 45 Broadway, N. Y.

For this second part of the Diesel conversion program, it is understood that bids will be asked on 2, 4, 6 and 8 ships and that all contracts will be made on this basis at one time.

Puget Sound Navigation Co. To Construct Two New Vessels

ACCORDING to official information received from Ira Bronson, president of the Puget Sound Navigation Company, Colman Dock, Seattle, Wash., plans and specifications are now being prepared for the construction of two new vessels, but are not far enough advanced to give further details at this time.

Colonial Navigation Co. Plans New Construction

WORD has been received at this office that the Colonial Navigation Company, N. Y., has revived its plans for the construction of two sound-type passenger steamers. This company maintains a service between New York and Providence. No information as to the size or general characteristics of these vessels is as yet available, but will undoubtedly be given out shortly. The company now operates four ships in the coastwise service ranging from 1,248 to 2,094 gross tons.

Dravo Co. Awarded Contract for Two Snag Barges

A CONTRACT for the construction of two 15-ton steel hull snag barges has been awarded to the Dravo Contracting Company, Dravo Building, Pittsburgh, Pa., by the United States Engineer Office, Memphis, Tenn., at a price of $35,940. Tenders for the work were received in Memphis some time ago.

The barges are to have a length overall, 84 feet; breadth, molded, 24 feet; depth at side, molded, 3 feet 6 inches; depth at centerline, molded, 3 feet 9 inches; camber (except at bow), 3 inches straight taper in 11 feet; draft when fully loaded, forward, 1 foot 1 inch; draft when fully loaded, aft, 1 foot 1 inch. The transverse system of framing is to be used.

Contract for Galveston City Fireboat Awarded

A CONTRACT for the construction of a fireboat for the city of Galveston, Tex., has been awarded to the Gibbs Gas Engine Company of Florida, Jacksonville, Fla., at an approximate cost of $150,000. The plans call for the construction of a vessel 87 feet long with a beam of 18 feet. She will be equipped with two 500-horsepower pumps. Two high powered Winton Engines, manufactured by the Winton Engine Company, Cleveland, Ohio, will also be installed. Construction of the fireboat will begin immediately and is expected to be completed during the next month.

Contracts for Dredge and Two Scows Awarded

A CONTRACT for the construction of a clam shell dredge has been awarded to the Moore Drydock Company, Oakland, Calif., by the Board of State Harbor Commissioners, Union Depot and Ferry House, San Francisco, at a price of $133,700 and a time of 180 days.

The board has also awarded a contract for the construction of two wooden dump scows to the General Engineering and Drydock Company, Alamenda, Calif., at a price of $39,136 and a time of 70 days.

Bethlehem Co. to Condition Three Matson Steamers

THE Bethlehem Shipbuilding Corporation, Ltd., at San Francisco, Cal., has been awarded contracts for reconditioning three former Transmarine steamers, recently purchased by the Matson Navigation Company, San Francisco, and which are to be used in the company's lumber trade between North Pacific ports and the Hawaiian islands. The Matson Line will expend approximately $60,000 each in reconditioning the steamers for the new service.

Two of the steamers, the *Sujerseyco*, to be renamed the *Makawao*, and the *Susherico*, to be renamed the *Manini*, are now in port in San Francisco, and the third, the *Suhulco*, to be renamed the *Makua*, is due to arrive at San Francisco within the next few weeks.

Midland Company to Build Six Barges

THE International Petroleum Company, Ltd., Toronto, Ont., has awarded a contract to the Midland Barge Company, Midland, Pa., for the construction of six oil barges for Magdalena river service, South America. The price involved was not given out.

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U. S. Engineer Barge Contract Awarded

THE United States Engineer Office, Chicago, Ill., has awarded a contract to the R. S. Newbold & Son Company, Norristown, Pa., for constructing and delivering one steel barge. The new barge is to have a length of 48 feet, beam of 18 feet and a depth of 4 feet 8 inches. Except where otherwise specified, all work is to be performed in accordance with the current rules of the American Bureau of Shipping. The Newbold Company submitted a price of $4,600. Bids for the work were received at Chicago recently.

Cowles-Lenahan Co. to Build Ten Barges

SINCE the passage of the Jones-White merchant marine bill, the Cowles-Lenahan Drydock, Inc., Buffalo, N. Y., which is a subsidiary of the Cowles Barge Company, has arranged to build two fleets of barges for barge canal use. Each barge is to be of steel construction, 108 feet long, 22 feet beam, 12 feet deep, and will carry 20,000 bushels of wheat. There will be five barges in each fleet so as to lock together with a towing unit in one of the locks of the barge canal.

S.S. Lingan Has Successful Voyage with Pulverized Coal Burners

THE Dominion Coal Company's steamship *Lingan* recently completed its first run between Sydney, N. B., and Montreal, Canada. This vessel is equipped with pulverized coal-burning apparatus recently installed by the Halifax Shipyards, Ltd., Halifax, N. S., under the direction of E. C. Bennett, naval architect, 30 Broad street, N. Y. The burners and distributors were supplied by the Peabody Engineering Corporation, New York, and the pulverizers by the Kennedy-Van Saun Manufacturing & Engineering Corporation, N. Y.

Following the first voyage, the engineers in charge of conversion carried out a series of experiments with various kinds of fuel.

Construction Program of Dollar Line Now Being Prepared

ACCORDING to an official statement by R. Stanley Dollar, vice president of the Dollar Steamship Line, San Francisco, Calif., to MARINE ENGINEERING & SHIPPING AGE, the "replacement program which has been under consideration for sometime past is not yet sufficiently crystallized to enable the publication of particulars." The needs of the trade routes served by the line are being carefully studied and a definite construction program will shortly be announced.

Various rumors have been circulated lately purporting to cover the Dollar Line construction plans. The first is that two motorships, costing about $9,000,000 each, would be built; one to be used for transpacific service and the second in round-the-world cruises.

The latest report given circulation is that the line contemplates the construction of five motor liners of over 600 feet in length and to be somewhat faster than the "President" class ships now operated in round-the-world service. These vessels, the reports state, would cost about $35,000,000.

Jones & Laughlin Co. to Build Towboat of New Design

INFORMATION has been received that the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., is expecting to build a triple-screw, 154-foot towboat, fitted with a new stern and rudder system, invented by Captain Philip C. Elsey, master of river transportation of the Vesta Coal Company, a subsidiary of the Jones & Laughlin Steel Corporation.

In this system, the after underwater body of the hull is tapered to a point. Two rudders, called flanking rudders, are placed ahead of the propellers and three rudders are placed behind the wheels. The propellers and rudders are protected by skegs which project downward at each side of the hull and, with the tapered part of the hull, form flank tunnels. When the flanking rudders are swung over to either extreme position, the water from all three propellers, when flanking, is directed through one of these flank tunnels. As designed, the vessel is equipped with three 500-horsepower Diesel engines, each driving a separate propeller.

U. S. Engineer Snagboat Contract Awarded

A CONTRACT for the construction of one 30-ton, steel hull, steam-driven, sternwheel snagboat for the United States Engineer Office, Memphis, Tenn., has been awarded to the Charles Ward Engineering Works, Charleston, West Va., at a price of $74,950. Bids for the boat were received at Memphis, recently.

The new vessel is to have the following dimensions: Length, molded, 127 feet; length overall, 146 feet 6 3/16 inches; breadth, molded, 30 feet; depth at side molded, 4 feet 4 inches; depth at center line, molded, 4 feet 10 inches; camber, 6 inches straight taper in 15 feet, and draft 2 feet 9 inches. She is to be equipped with two propelling engines of the horizontal high pressure simple type, with cranks of the wheel shaft set at 90 degrees. The boilers are to be constructed for a working pressure of 200 pounds per square inch.

Munson Line to Alter Two Vessels

PLANS are now under way at the offices of the Munson Steamship Line, 67 Wall street, N. Y. C., for altering the engines of two of their *Western World* class ships in the South American run, in order to increase the speed. The vessels under consideration have a length of 516 feet, breadth 72 feet, depth 28 feet and a gross tonnage of 13,700.

Cowles Towing Co. Plans Diesel Tugboat

THE Jones-White merchant marine bill, which was recently signed by President Coolidge, has induced the Cowles Towing Company, Inc., 360-370 Ohio street, Buffalo, N. Y., to arrange plans for the construction of a steel Diesel tugboat, 75 feet long, with a 360-horsepower engine. The vessel will cost approximately $60,000.

U. S. Engineers Desire One Barge

INFORMATION has been received that the United States Engineer Office, Memphis, Tenn., is in the market for one barge. Additional details will be published at a later date.

U. S. Engineers Require Two Barges

THE United States Engineer Office, New Orleans, La., will shortly be in the market for two 7 feet by 30 feet by 120 feet steel barges. Further details will be available at a later date.

Ships Must be Serviceable as Naval Auxiliaries in Order to Obtain Government Loan

INFORMATION has been received that Government money will not be advanced by the United States Shipping Board for building foreign trade ships unless serviceable as naval auxiliaries in time of national stress under the liberalized terms of the $250,000,000 construction loan fund provided by the Jones-White act. This definite stand will be taken by the board because it has already been confronted with applications for loans from parties who wish to build ships of domestic commercial value but of doubtful service in time of emergency.

Four Day Liner Plans Submitted to Navy Department

INFORMATION has been received that plans and specifications for the construction of six four-day trans-atlantic passenger liners, which the Transoceanic Corporation of the United States proposes to build under loan provisions of the Jones-White act, have been submitted to the Navy Department by Lawrence R. Wilder, president of the corporation.

At the same time it was discovered that nothing definite has as yet been decided upon by the Navy Department for the consideration of plans submitted by the Transoceanic and other corporations seeking construction loans. It was considered likely, however, that within a few days the work will be delegated to the Bureau of Naval Operations, probably to the War Plans Division.

Bids for New Mail Contracts to Be Opened July 9

POSTMASTER General H. S. New has issued advertisements which set forth the provisions of the new mail contracts and bids will be opened in Washington on July 9. Quick action is necessary, according to Mr. New, because the service is to begin August 1, or soon thereafter. The Postmaster General will set forth the speed required in the various routes, the rates that will be paid and the number of voyages necessary to facilitate the movement of mails.

Several of the routes are being served by only one regular American flag service, and, as most of these are made up of former Shipping Board tonnage, it is expected that the mail contracts will go to these companies.

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Construction and Repair Bids

Pusey & Jones Corp. Bids Low for Construction of New Geared Turbine Drive Steamer

IT has been reported that The Pusey & Jones Corporation, Wilmington, Del., was low bidder on the construction of a new steamer, tenders for which were opened at the office of Cox & Stevens, naval architects, New York, on June 12.

This vessel, which will be driven by geared turbines will have a length of 300 feet, a beam of 40 feet and a depth of 25 feet. Steam will be supplied by four watertube boilers to turbines developing 6,000 shaft horsepower.

Six shipyards on the east and west coasts submitted proposals on this work for which no award has as yet been made. No definite action on the building of this vessel will be made at once as it is considered that the bids submitted were too high for immediate construction. Further details covering the work will be available at a later date.

U.S.S. Receives Bids to Supply Eight Main Switch Boards

TENDERS were received at the office of Captain R. D. Gatewood, manager of the maintenance and repair division of the United States Shipping Board, 45 Broadway, N. Y., June 26, for furnishing eight main switch and control boards, one for each of the eight Shipping Board vessels which are to be converted to Diesel-electric drive. The switch boards, which will control the current for both power and light, and the motor starters for the auxiliaries, will be located in the engine room.

Bids for the Construction of a Diesel-electric Survey Ship

SEALED proposals were received by the United States Coast & Geodetic Survey, 205 New Jersey avenue, S. E., Washington, D. C., at 11:00 A. M., June 22, for the construction of a steel, single-screw, Diesel-electric propelled survey ship. At the same time proposals were opened for furnishing the main propelling machinery and separate proposals for various auxiliaries. The new survey ship is to be named the *Hydrographer*. General dimensions and power are as follows:

Length overall, molded.....167 feet 5 inches
Length between perpendiculars..143 feet 0 inches
Beam, molded ..... 31 feet 6 inches
Minimum depth from top of main deck at side..... 18 feet 2 inches
Displacement molded at 10 feet 6 inches mean draft, salt water, approximately .....740 tons
Draft, forward ..... 9 feet 6 inches
Draft, aft ..... 11 feet 6 inches
Drag ..... 2 feet 0 inches

Main propelling motor (furnished by the Government), one double-armature electric motor, shaft horsepower (estimated), 640 at 125 revolutions per minute.

The ship will be equipped with the latest and most modern facilities for sounding operations in hydrographic work, including instruments for echo sounding and instruments for radio acoustic ranging for determining a ship's position offshore. All the auxiliaries will be motor-driven and are designed for maximum efficiency under difficult working conditions.

Tenders for Building Two Carfloats Opened

TENDERS for the construction of two steel carfloats were recently opened privately by the Western Pacific Railroad Company and the Sante Fe. Both of the floats are to be used in the San Francisco bay service of the respective companies.

The floats will contain four car tracks and will accommodate twenty cars each. They will be 250 feet long, and if built according to specifications, will be as modern and up-to-date as the last carfloat constructed for the Santa Fe Company, which is rated as the most modern as well as largest carrier of its kind on the bay.

No word has as yet been received from either company as to who the successful bidder is.

Bids for Mat Barge Construction Opened

TENDERS were received at the United States Engineer Office, Third District, Vicksburg, Miss., on June 5, covering the construction of one steel hull for a mat barge. The hull is to have a length of 120 feet, width 50 feet and depth 9 feet. The new hull is for laying small mats in connection with a large mat laying plant. The bids submitted were as follows:

Name	Price	Calendar Days
Dubuque Boat & Boiler Works.	$ 22,000	150
Zier Boiler & Sheet Iron Company	23,456	200
Riter-Conley Company	24,790	60
Dravo Contracting Company	24,885	110
Nashville Bridge Company	26,940	140
Howard Shipyards & Dock Company	27,370	100
Alabama Drydock & Shipbuilding Company	27,670	150
Midland Barge Company	27,900	120
Charles Hegewald Company	29,900	200

The Riter-Conley Company, 1201 Oliver building, Pittsburgh, Pa., has been recommended for award.

N. Y. State Ferryboat Bids Opened June 26

TENDERS for the construction of two 115-foot Diesel-electric ferryboats for the State of New York, were received and opened at the offices of Eads Johnson, naval architect, 115 Broadway, N. Y., on Tuesday, June 26. Plans and specifications for the work were prepared by Mr. Johnson.

Robins Co. to Repair S.S. American Banker

THE United States Shipping Board has awarded a contract to the Robins Drydock & Repair Company, Brooklyn, N. Y., covering repairs to the steamship *American Banker*. Tenders for the work were received in the New York office of the board recently. Four bids were received as follows:

Name	Price
Robins, Drydock & Repairs Company	$ 7,270
W. & A. Fletcher Company	7,944
Theodore A. Crane's Sons Company	9,843
Morse Drydock & Repair Company	12,354

Bids Asked for Constructing Nine Steel Needle Flats

SEALED proposals were received by the United States Engineer Office, Box 72, Louisville, Ky., on June 11, for furnishing all labor and materials, constructing and delivering nine steel needle flats. The award has not as yet been made, but is expected shortly.

S.S. Mexican Repair Contract Awarded

A CONTRACT for repairs to the American-Hawaiian Co. steamship *Mexican* has been awarded to the San Francisco plant of the Bethlehem Shipbuilding Corporation, Ltd., at a price of $93,139 and a time of 30 days. The vessel recently struck a submerged object on her voyage to San Francisco from the Atlantic Coast. Four other tenders were submitted for the work as follows:

Name	Price	Days
General Engineering & Drydock Company	$98,500	35
Moore Drydock Company	98,865	35
Hanlon Drydock & Shipbuilding Company	99,540	50
Los Angeles Shipbuilding & Drydock Corporation	108,650	37

Due to the accident and consequent lay-up of the *Mexican*, the American-Hawaiian motorship *Missourian* is now on the original schedule of the *Mexican*.

Fireboat William J. Gaynor to be Repaired at Todd Drydock

THE City of New York Fire Department has awarded a contract to the Todd Drydock, Engineering & Repair Corporation, Brooklyn, N. Y., covering repairs to the fireboat *William J. Gaynor*, at a price of $11,712, bids for which were recently received. Four other proposals were received for the work as follows:

Name	Price
John W. Sullivan Company	$13,250
Morse Drydock & Repair Company	13,337
Staten Island Shipbuilding Company	13,912
Ira S. Bushey & Sons, Inc.	14,083

The work covered by the contract is extensive and includes the overhauling of the boilers and the installation of a new deck, besides the usual procedure of drydocking and painting the underwater portions of the vessel.

Dredge Blackwater Hull Bids Opened

TENDERS were received and opened recently by the United States Engineer Office, Montgomery, Ala., covering the construction of a steel hull for the dredge *Blackwater*. The hull is to be 150 feet by 38 feet by 6½ feet. The bids received were as follows:

Name	Price
Alabama Drydock & Shipbuilding Company	$31,974
Dravo Contracting Company	32,550
Midland Barge Company	34,000
Howard Shipyards & Dock Company	37,000
Nashville Bridge Company	39,230
J. S. Schofield & Sons	42,900
Charleston Drydock & Machine Company	48,541
Todd Shipbuilding & Drydock Company, Inc.	49 990
Charles Ward Engineering Works	63,400

The contract has not as yet been awarded so far as is known.

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Bids Received for Constructing Four Steel Barges

SEALED proposals were received by the United States Engineer Office, Federal building, 16th street and 2nd avenue, Rock Island, Ill., until 11:00 A. M., June 20 for furnishing all labor and materials and performing all work for constructing and delivering four 70 feet by 16 feet by 4 feet full deck small steel barges. Further information may be obtained upon application.

S.S. Eastern Glade Repair Bids Opened

WITH a price of $7,600, the Theodore A. Crane's Sons Company, 25 Broadway, N. Y., submitted the lowest proposal covering repairs to the American South African Line steamship *Eastern Glade*, bids for which were received in New York recently. Other proposals received for the work were:

Name	Price
Morse Drydock & Repair Company	$ 7,707
New York Harbor Drydock Company, Inc.	8,900
Federal Shipbuilding Company	8,960
Tietjen & Lang Drydock Company	9,440
Robins Drydock & Repair Company	9,950
Todd Drydock, Engineering & Repair Corporation	10,242
W. & A. Fletcher Company	10,424
James Shewan & Sons, Inc.	10,902

S.S. Jefferson Repair Contract

BIDS were recently received by the Eastern Steamship Lines, Inc., Boston, Mass., covering general repairs to the steamship *Jefferson* and a contract for the work was awarded to the Tietjen & Lang Drydock Co., Hoboken, N. J. Other tenders received were as follows:

Name	Main Item	Additional Items	Total	Days
Tietjen & Lang Drydock Company	$11,416	$23,170	$34,586	40
Morse Drydock & Repair Company	11,666	25,518	37,184	32
Robins Drydock & W. & A. Fletcher Company	12,879	28,077	40,956	54
Bethlehem Shipbuilding Corporation, Ltd.	13,850	.....	.....	15

Carfloat No. 58 Repair Contract Awarded

THE Staten Island Shipbuilding Company, Staten Island, N. Y., has been awarded a contract covering deck repairs to the New York, New Haven & Hartford Railroad carfloat *No. 58*, at a price of $12,980 and a time of 18 days. Bids for the work were received in the New York office of the Railroad. Other tenders submitted were:

Name	Price	Days
John W. Sullivan Company	$12,606	25
James Shewan & Sons, Inc.	13,804	22
Tietjen & Lang Drydock Company	15,411	18
Morse Drydock & Repair Company	16,479	16
Todd Drydock, Engineering & Repair Corporation	16,940	18
Theodore A. Crane's Sons Company	19,307	18

Several prices were submitted on a number of miscellaneous items which were not figured in the totals.

Great Lakes Notes

Oil Tanker Launched at Lorain

THE 400-foot oil tanker *Martha E. Allen* which is being constructed at the Loraine yards of the American Shipbuilding Company for the Lake Tanker Corporation was launched June 9. The corporation specializes in shipment of oil and petroleum products. This launching was the first in Lorain since last December.

Increased Draft of Lake Vessels Recommended

AN increase of three inches in draft has been recommended by the shore captains committee of the Lake Carriers' Association. This means that for general navigation the draft will be 19 feet 9 inches, and for upbound ships in St. Mary's river it will be 19 feet 3 inches.

Collision of Steamships John Ericsson and A. F. Harvey Due to Fog

THE substance of testimony before the Buffalo board of the United States Steamboat Inspection Service regarding the collision of the whaleback steamer *John Ericsson* of the Peterson Steamship Company and the steel freighter *A. F. Harvey* of the Pittsburgh Steamship Company, May 25, was to the effect that the accident was due to a heavy fog. Both ships were checked, both blew the usual distress signals but witnesses said that it was impossible for the ships to locate each other. One wheelman said that he could not see the bow of the Ericsson from the pilot house because of the dense fog. The consensus of opinion was that the two ships were picking their way when the accident occurred at 11 a. m. and checked their speed when the collision appeared inevitable.

Tomlinson Sells Two Lake Steamers

G. A. TOMLINSON, Cleveland, O., announced on June 12 the sale of the lake steamers *David S. Troxel* and *Crescent City* to the Nicholson Universal Steamship Company. The ships have been operated by the Duluth Steamship Company, managed by Mr. Tomlinson. This brings the fleet operated and managed by Captain Nicholson up to seven ships aand two tugs. The Nicholson fleet is largely engaged in transporting automobiles making almost daily runs to Cleveland.

Tug Colorado Completed

THE new steel tug *Colorado* built at the yards of the Great Lakes Towing Company, Cleveland, O., was placed in commission June 2, as the eleventh unit of the Hand & Johnson fleet at Buffalo. The addition of this powerful modern towing machine to the local fleet gives Buffalo more harbor tugs than any single port on the Great Lakes. There are seven of the larger type and four of the smaller.

Equipped with everything needed in a modern tug, the *Colorado* is larger and more powerful than any other tug in the Hand & Johnson outfit. She has a 26 by 28 high pressure engine, 160 pounds of steam, with steam reverse. She can make eleven miles an hour without difficulty, and is well equipped for ice-breaking purposes as well as for general harbor work.

Propulsion is by a high pressure engine 26 inches diameter by 28 inches in stroke, supplied with steam at 160 pounds per square inch. John H. Myers is chief engineer of the tug.

Court Decision Affects Navigation on the Lakes

A RECENT decision of the United States Supreme Court affecting navigation on the Great Lakes is one of the most important in marine history, according to A. A. Schantz, president of the Detroit & Cleveland Navigation Company.

The court reversed a ruling that a vessel having the right of way is required to change its course to avoid a collision. The decision followed a collision in November, 1922, of the steam schooner *Svea* and the Pacific Mail steamship *Newport*, 12 miles out from San Francisco, when the *Svea* had the right of way and held her course.

"The ruling definitely affects Great Lakes traffic, particularly in dangerous channels where either an upbound or a downbound boat is given the right of way," Mr. Schantz said.

Channel Scow Delivered

A CHANNEL scow, the first of its kind to be constructed at the American Shipbuilding Company plant at Lorain, O., was delivered last month to the Bradley Steamship Company of Cleveland, for hauling stone in the Calcite stone district. The scow is 100 feet in length and 34 feet wide.

Great Lakes Repairs

The 5,300 gross-ton steamship *W. E. Fitzgerald* of the Chicago Navigation Company, Chicago, Ill., has gone on the ways of the Wheeling & Lake Erie docks, where she will be equipped with self-unloading machinery. It will require sixty days to complete the work

The steamship *John Ericsson* of the Peterson Steamship Company, Cleveland, O., has been docked at the yards of the Toledo Shipbuilding Company, Inc., Toledo, O., where she will have 35 new plates installed and other repairs made, as a result of her recent collision with the freighter *A. F. Harvey*.

The steamer *L. C. Hanna* has been docked at the yards of the American Shipbuilding Company, Cleveland, O., for repairs.

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The steamers *W. C. Richardson* and *Wickwire* were recently in collision at Detroit, Mich. The *Richardson* was docked at Cleveland for repairs and the *Wickwire* was docked at Detroit for temporary repairs.

Ten Great Lakes Vessels Renamed

ACCORDING to data just released by the Lake Carriers' Association, Cleveland, Ohio, the names of ten ships engaged in Great Lakes trade have been changed this year. This probably marks the largest number of boats that have had their names changed in the beginning of a season. Most of the changes have come about through purchases made, and in one instance it was due to a boat going back to the original owners.

Four vessels in the fleet of the Paisley Steamship Company interest have been renamed as follows:

New Name	Old Name
O. S. McFarland	*M. A. Reeb*
William Nelson	*Panay*
Thomas Britt	*G. N. Wilson*
M. J. Bartelme	*Central West*

Three vessels managed in the G. A. Tomlinson fleet are:

New Name	Old Name
Sinaloa	*William F. Rapprick*
Sonoma	*David S. Troxel*
E. M. Young	*Hoover & Mason*

The Interlake Steamship Company has changed the name of one vessel:

New Name	Old Name
Cetus	*S. H. Squire*

One ship has been renamed by the Spokane Steamship Company:

New Name	Old Name
J. T. Reid	*James B. Neilson*

The tenth ship owned by the Sullivan fleet has been changed as follows:

New Name	Old Name
J. E. Savage	*Thomas Britt*

Of these the *J. E. Savage, Sinaloa* and *E. M. Young* have been changed to self unloaders while the *W. E. Fitzgerald* has been equipped with self unloading machinery.

Port of Newark Shows Great Increase in Business

A PHENOMENAL growth of business at the Port of Newark is shown in statements issued by Peter J. O'Toole, Jr., supervisor of the port, and Mayor Thomas L. Raymond of Newark. The revenue received by the Bureau of Docks as a result of the handling of cargoes over municipal docks in 1925, the first year they were in use, was $1,528.92. In 1927 the revenue from the same source was $12,959.30. The revenue derived from dockage and wharfage fees for the first four months of 1925 amounted to $195.41, whereas for the first four months of 1928 it amounted to $6,354.72.

Ships of the Dollar Steamship Line, the Williams Steamship Company, and the Moore & McCormack Company, Inc., discharging lumber cargo at the municipal docks, paid to the city in four days, in May, 1928, charges amounting to $1,640.00 as compared with a dock income in the entire year 1925 of $1,528.92.

Approximately 700 ships are scheduled to arrive at and depart from the port this year with aggregate crews of about 21,000 seamen. During the year 1927, a total of 330,302 tons of lumber and miscellaneous freight was carried in and out of the Port of Newark by 48,113 trucks. For the first four months of this year, 23,264 trucks carried 225,200 tons. In the same four months 4,059 loaded cars were handled, with a total tonnage of 162,360 tons. The general cargo — consisting mainly of brick, French pipe, sulphur, German barytes and sugar, etc.—amounted to 142,971 tons. Also in this period approximately 60,000,000 feet of lumber has been received.

Model of Motor Liner Kungsholm on Exhibit

A 12-foot model of the new motorship *Kungsholm*, of the Swedish American Line, built for passenger traffic between New York and Gothenburg, Sweden, is being exhibited at the company's offices at 21 State Street, New York.

The *Kungsholm*, which is Scandinavia's largest and most modern and luxurious passenger liner, will make her maiden voyage from New York to Gothenburg on December 8.

Red D Line Celebrates 100th Anniversary

THE 100th anniversary of H. L. Boulton & Company of Caracas, Venezuela, who have acted as general agents of the Red D Line since the line was inaugurated four generations ago, was celebrated last month.

In 1833 this firm joined in partnership with John Dallett of Philadelphia. This partnership was later dissolved and the two firms of Dallett Bros. and H. L. Boulton & Company continued in business relations. The business started in Philadelphia in 1838 by Dallett Bros. virtually established what was to be known afterwards as the Red D line of steamships.

The Red D Line today owns and operates seven vessels in a weekly mail, freight and passenger service between New York, San Juan, La Guayra, Puerto Cabello, Curacao and Maracaibo, and return. These are the *Caracas, Carabobo, Lara, Maracaibo, Falcon, Tachira* and *Trujillo*.

Marine Engineers' Wage Scale Unchanged

SHIPPING BOARD engineers of all classes during the coming fiscal year will receive the same wages and work under the same rules as prevail at present under an agreement reached on June 13 at the annual conference between representatives of the National Marine Engineers' Beneficial Association, the Shipping Board and the Merchant Fleet Corporation.

Representatives of the engineers' organization asked for renewal of the present scales and conditions, which expire June 30, and the board and Fleet Corporation officials acceded to the request. The rates and conditions are under a special engineering classification, of the type embraced in the Dieselization program of the board.

The rates that will be in effect for another year are as follows: Chief engineers, from $240 to $300 a month; first assistant engineer, $175 to $195; second assistant, $155 to $175; third assistant, $140 to $155; fourth assistant, $135 to $140, and junior engineers, $120 flat.

Conditions Revised for Award of Miller Medal

THE board of trustees of the Samuel Wylie Miller Medal, which has been established by Past-President Miller, of the American Welding Society, received no paper during the calendar year 1927 of sufficient value to merit the award for that year. The board has, therefore, revised the conditions under which the medal may be awarded as follows:

1. The medal may be awarded annually for any meritorious achievement which, in the judgment of the board of trustees, has contributed conspicuously to the advancement of the art of gas fusion welding and cutting or the art of electric arc fusion welding and cutting.
2. The award for any calendar year shall be announced and the medal, together with a suitable certificate, presented at an annual meeting or a Fall meeting of the society as the board of trustees may elect.

The conditions governing the award of this medal have been made very broad so that it can be granted for an achievement of any character which has contributed conspicuously to the advancement of either of the two branches of the welding art which are specifically mentioned. Thus, the award may be made for a meritorious paper or an invention or a conspicuous application of welding in industry which has advanced the art either on account of unique technical features or important economic advantages. The award may even be made for conspicuous service of a non-technical character which distinctly advances the welding art.

Preparations for World Engineering Congress Under Way

DURING the nine months since it was announced that a World Engineering Congress would be opened in Tokio in October, 1929, considerable progress has been made in the preparatory work of the congress. The technical program has been issued with a revised compilation of the list of subjects of papers to be read at the meeting.

Of particular interest to those in the shipbuilding and marine engineering field will be the discussion of the following subjects:

Theoretical naval architecture, construction of ships, governmental and classification society's regulation rules for shipbuilding and marine engineering, main and auxiliary machinery, equipments of shipbuilding yards, ship equipments, lifesaving appliances, etc.

Electrical Equipment for Two Pennsylvania Railroad Diesel-Electric Tugs

CONTRACTS have been awarded by the Pennsylvania Railroad to the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for complete electrical equipment to be installed on the two Diesel-electric tug boats which were recently ordered. These new boats will increase the Pennsylvania Railroad's fleet of Diesel-electric tug boats to nine, all of which were equipped by the Westinghouse company. The principal dimensions of the two boats are:

Length overall	105 feet
Beam, loaded	24 feet
Draft	12 feet
Gross tonnage	186
Speed, light	11¼ knots

The propelling equipment will consist

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of two main generating units and a double armature propulsion motor. Each generating unit will be comprised of a 375 brake horsepower Winton Diesel engine driving a 250-volt, 235-kilowatt generator and a 25-kilowatt exciter at 260 revolutions per minute. The generator and exciter will be directly connected to the engine shaft. Control will be arranged for both pilot house and engine room, the Westinghouse variable voltage system being used

University of Pennsylvania Offers Course in Fuel Engineering

THE Towne Scientific School of the University of Pennsylvania has announced a one year course in fuel engineering leading to the degree of Master of Science in Fuel Engineering. This course will open October 1, 1928, and will embrace such subjects as fuel resources, mining methods, preparation for market, distribution, storage and rehandling, composition and combustion of fuels, manufacture of special fuels, uses of fuels and specifications for purchase, furnaces, fuel sampling, analyses and calorimetry, fuel testing in heating and power appliances and research.

The course is under the direction of Professor William H. Kavanaugh, M. E., and instruction will be given by a large staff of lecturers composed of a number of nationally recognized authorities in the several subjects.

Shipping Board Receives Bids on Several Idle Freighters

TENDERS were received recently, by the United States Shipping Board for the purchase of several idle freighters on the Pacific Coast. The following tenders were submitted:

Charles Nelson Company, San Francisco, Calif., $30,000 for the steamship *Delight*, with the proviso that new boilers be installed in the vessel.

Frank Seth, representing the Bethlehem Steel Corporation, Pa., $46,000 for the steamship *Diablo*.

W. J. Gray, Jr., bid $46,000 for the steamship *Haynie* and Walter Johnson of the Union Construction Company of San Francisco, $51,000 each for the *West Harts* and *West Hartland*.

Learner & Rosenthal, junk dealers of Oakland, bid $64,563 for the steamships *Heber, Diablo, Mercer, Havilah* and *Haynie*. This firm also bid $14,000 for the steamship *Fort Wayne*, $10,000 for the steamship *Alloway* and $11,000 for the steamship *Iconium*.

The Clinchfield Navigation Company, N. Y., submitted a bid of $150,000.

Haskelite Used in Living Quarters of the Savarona

IN the description of the motor yacht *Savarona*, published page 263 of our May issue, mention was inadvertently omitted of the fact that Haskelite, supplied by the Haskelite Manufacturing Corporation, 133 West Washington street, Chicago, Ill., was used throughout the living quarters of this luxurious yacht.

The *Savarona* was built by Pusey & Jones Company, Wilmington, Del., for Richard M. Cadwalader, Jr., of Philadelphia, in accordance with designs by Henry J. Gielow, Inc., naval architect, New York. The vessel is 294 feet long overall and has a speed of 16 knots.

General Electric Co. Awarded Contract for Turbo-electric Machinery

A CONTRACT for the construction of a turbo-electric power plant for the Oriental Steam Navigation Company's newest ship now being built in England, has been awarded to the General Electric Company, Schenectady, N. Y. The vessel will be of 19,000 tons and the main propelling machinery similar to that in the Panama Pacific Line's passenger ship *California*, completed last year at the yards of the Newport News Shipbuilding & Drydock Company, Newport News, Va.

Weekly Engineering Index Service Now Available

OF interest to engineers is the announcement that the Weekly Engineering Index Service supplied by the American Society of Mechanical Engineers is now in full swing. This is an extension of the old Engineering Index which has served members of the profession for the past 44 years. The new development of this unique service makes available to engineers the best of current thought and research regularly and without delay.

By this service valuable material in the 1,700 odd publications, received by the United Engineering Societies Library, is reviewed by a staff of editors qualified by practical field experience. Each article is then briefly described in a carefully prepared note, and these notes are classified under one of the 13 subject headings in which the different phases of engineering interest are listed. They are then printed on index cards, convenient for filing, and sent each week to subscribers.

The classification "Naval and Marine" which gives to naval and marine engineers in readily available form the information they desire about their particular work, is sub-divided as follows:

II. NAVAL AND MARINE:
- A. HULLS-Commercial-Types, design, construction, materials, equipment, etc.
- B. HULLS-WARSHIP-Same as 11A.
- C. HULLS-YACHT-Same as 11A.
- D. POWER-COMMERCIAL-Machinery, auxiliary, accessories, trial trips, etc.
- E. POWER-WARSHIPS-Same as 11D.
- F. POWER-YACHTS-Same as 11D.
- G. SHIPYARDS AND DOCKYARDS. Layout, shipways, dry docks, equipment, operation, etc.
- M. MISCELLANEOUS-Other naval architecture and marine engineering subjects not otherwise classified.

Full information concerning this service, which is supplied practically at cost, together with sample index cards, may be obtained by addressing Major Carlos de Zafra, director, the Engineering Index Service, 29 West 39th Street, New York, N. Y.

Union Oil Company Asks Bids for Building New Tanker

IT has been learned that the Union Oil Company of California, Union Oil building, Los Angeles, Calif., is asking for bids for the construction of one small tanker for coastwise service. The new tanker will have a deadweight of about 1,200 tons and will be propelled by Diesel engines.

Financial

I. M. M. Shows Surplus for 1927

The consolidated results of operation of the International Mercantile Marine Company and its subsidiaries for 1927 shows a surplus of $561,054, as compared with a deficit of $1,483,139 for 1926.

N. Y. K. Declares Dividend

The Nippon Yusen Kaisha of Tokio has declared a dividend of 8 percent as a result of the report that the profit of the company for the six months ended March 31 amounted to 3,090,000 yen.

A. G. W. I. Doubles Income in Quarter

The Atlantic, Gulf & West Indies Steamship Lines report a net income of $651,555 in the quarter ended March 31 against $341,610 in the same quarter a year ago.

Todd Shipyards Show Earnings

The consolidated income statement of the Todd Shipyards Corporation for the year ending March 31 shows a net income of $623,014 after depreciation Dividends paid during the year amounted to $840,221.

Eastern Steamship Lines Show Deficit

The Eastern Steamship Lines report a deficit of $84,617 for April 1928 after charges as compared with a net income of $26,604 for April, 1927. For the four months ended April 30, there was a deficit after charges of $321,170. The company declared the regular quarterly dividends of $1.75 on the first preferred and $0.875 on the no-par preferred.

Great Lakes Transit Corp. Dividends

The directors of the Great Lakes Transit Corporation of Buffalo, N. Y., have declared a quarterly dividend of $1.75 a share on preferred stock.

Supply Trade

Welders Optimistic of Future of Arc Welding

AT the meeting of the American Welding Society held recently at Cleveland, Ohio, it was pointed out by many eminent speakers that arc welding is an art that cannot be dispensed with. William D. Guion stressed the urgent need for handbooks on arc welded construction so that building codes may be intelligently compiled to include the new method of construction.

The rapid advancement of the design of electric arc welding equipment and the improved methods of welding were dealt with in an address by J. F. Lincoln, vice-president of The Lincoln Electric Company. "Arc welding in structural work is now where riveting was twenty years ago in regard to costs but from present indications there is every reason to believe that arc welding within the next five years will advance far beyond the present state of riveting," said Mr. Lincoln. He

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stated that though in some cases the cost of arc welding has exceeded the cost of riveting, not only in structural work but in the manufacture of steel pipe, tanks, girders, etc., a recent discovery by the research laboratories of The Lincoln Electric Company of a new welding process known as the electronic tornado has been perfected to such a degree that present welding costs can be reduced 75 percent by the new process.

Business and Personal

The second issue of *The Auroco News* has been received from the **Automotive Royalties Corporation, Inc.,** New York City. This pamphlet is devoted to the publication of information concerning various new inventions and newly manufactured products in the automotive field.

The **Builders & Industrial Supply Company,** Toledo, Ohio, is handling the various products of the **Botfield Refactories Company,** Philadelphia, Pa., in the vicinity of Toledo, Ohio..

The marine department of the **J. L. Mott Iron Works** has moved its office, show room and warehouse to 96 Pine street, New York.

Due to a marked increase in business during the past year, the **Peabody Engineering Corporation,** 110 East 42nd street, New York, has increased its engineering personnel and has leased additional space at its New York office.

The **Williams Steamship Company, Inc.,** which operates a service from New York to Pacific coast ports, has removed its berth from Pier 1, Erie Basin to the foot of 30th street, Brooklyn, N. Y.

The Boston office of **Sanderson & Son,** agents for the **Royal Mail, Lamport & Holt** and **Pacific Steam Navigation Lines,** has been closed and the business will be handled by the Boston office of the **International Mercantile Marine Company.**

T. Ishitani, former manager of the Calcutta branch office of the **Nippon Yusen Kaisha,** has been appointed manager of the New York office of the line, succeeding **S. Sakamoto,** who is returning to Japan.

Trade Publications

WINCHES. — The Stimmel Winch & Machine Works, New York, has distributed a group of folders in which truck winches, derrick and boat winches are described as well as capstans for various purposes.

ELECTRICAL EQUIPMENT.—A group of bulletins covering turbines, generator motors, switches and controls have been distributed by the General Electric Company, Schenectady, N. Y.

WELDING EQUIPMENT.—A folder has been received from the Fusion Welding Corporation of Chicago in which the merits of the Fuzon welder are explained.

CASTINGS. — The Peerless Products Company of New York has issued a pamphlet describing their ability to manufacture small and ornamental castings.

STARTERS.—The Monitor Controller Company, Baltimore, Md., has issued price lists and part lists covering standard and junior size Monitor thermaload starters.

HEAT ENGINEERING. — The Foster Wheeler Corporation of New York has published the bulletin "Heat Engineering" in which the installation of jet condensers on the Great Lakes car ferry *Wabash* is described.

LUBRICATION.—The Texas Company, New York, has described the factors involved in lubricating the steam turbine in the March, 1928, issue of "Lubrication" a technical publication devoted to the selection and use of lubricants.

HARDWARE.—A catalogue of marine hardware and general ship chandlers goods has been received from DeGrauw, Aymar & Company, New York, in which numerous articles of nautical application are described with current prices.

COMPRESSORS. — The Ingersoll-Rand Company, New York, has published a new 44-page bulletin on ER and FR compressors and vacuum pumps. These are the small and intermediate size machines produced by the company.

ALLOY STEEL.—The International Nickel Company, New York, has published an article entitled "Alloy Steel for Boiler Construction" by Charles McKnight. This paper points out the fact that nickel steel offers many advantages in the modern trend toward higher operating temperatures and pressures in boilers.

S. S. MERCER.—A souvenir booklet descriptive of the first ocean voyage of any vessel under power produced by pulverized coal has been issued by the Kennedy-Van Suan Manufacturing & Engineering Corporation, New York.

ABRASIVE METAL.—Alumalun, Feralun and Bronzalun are described in a pamphlet entitled "For Safety Sea Legs" issued by the American Abrasive Metals Company, New York. These products are used for antislip treads and floor plates where the danger of slippage is present.

FOAMITE—The American La France & Foamite Corporation, Utica, N. Y., has published a bulletin entitled "Needless Ruin" which describes an installation of the Foamite foam generator and the Foamite generator system, as applied to the protection of boats against fire.

PACKING. — The National Asbestos Packing Manufacturing Company, Inc., New York, has issued a catalogue of various packings for use with steam, gas, air, water and ammonia. The application of National packing has proved satisfactory for marine and stationary boilers, engines and pumps.

RUBBER BEARINGS.—The B. F. Goodrich Rubber Company, Akron, Ohio, has issued a pamphlet describing the cutless rubber stern and strut bearings which are manufactured to take the place of the customary metal or lignum vitae propeller shaft bearings without change in size. They are lubricated entirely by water, and will not score the shaft.

Marine Societies

America

American Marine Association, 30 Church St., New York. President—Col. E. A. Simmons.

American Marine Standards Committee. Chairman, Colonel E. A. Simmons. Secretary, A. V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

American Society of Marine Designers. Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

American Society of Marine Engineers. 605 Market St., San Francisco, Calif. Presiednt—Henry F. Gelhaus. Secretary—W. H. Thille.

American Society of Naval Engineers. Navy Department, Washington, D. C. Secretary Treasurer & Commander H. B. Hird, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

American Steamship Owners' Association, 11 Broadway, New York. President—H. B. Walker.

Atlantic Coast Shipbuilders' Association. 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

Council of American Shipbuilders, Inc., 50 Broadway, New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

Jersey Marine Club, 4th and River Streets, Hoboken, N. J. Secretary—Fred L. Broad.

Lake Carriers' Association. President J. S. Ashley. Secretary—George A. Marr, Rockefeller Building Cleveland O.

National Association of Engine and Boat Manufacturers, 29 West 39th Street, New York City. Secretary—Ira Hand.

National Association of Masters, Mates and Pilots, National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

National Marine Engineers' Beneficial Association. Headquarterse 311-315 Machinists Build-Ing. Washington, D. C. Prsident—Wm. F. Yates. Secretary—Albert L. Jones.

Neptune Association, 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Mil'iken.

New York and New Jersey Dry Dock Association. 111 Broadway, New York. President—Jonathan Moore.

Ocean Association of Marine Engineers. 15 Whitehall St., New York. Secretary—Bert L. Todd.

Port of New York Authority. 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

Society of Naval Architects and Marine Engineers, 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

The Maritime Association of the Port of New York, 78 Broad St., New York City President—John Dowd Secretary—John F. Manning.

The New York Tow Boat Exchange 11 Moore St., New York. Manager—Langdon W. Smith.

The Propeller Club of the Port of New York. President—Harry W. Parsons, 111 Broadway, New York. Secretary—W. Z. Gardner, 136 Liberty Street, New York.

United States Naval Institute. Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

United States Ship Operators' Association, 149 Broadway, New York. President—Winchester Noyes.

Canada

Grand Council N. A. of M. E. of Canada. Grand Secretary-Treasurer—W. A. MacDonald 62 Albert St, Halifax N. S:

Great Britain

Institute of Marine Engineers Incorporated, 85-88 The Minories, London E.1.

Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow.

Institution of Naval Architects, 5 Adelphi Terrace, London, W. C.

North East Coast Institution of Engineers and Shipbuilders. Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

France

Association Technique Maritime et Aëronautique. Secrétariat Genéral—7, rue de Madrid, Paris (8e).

Italy

Collegio Degli Ingegneri Naval e Meccanici In Italia.

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